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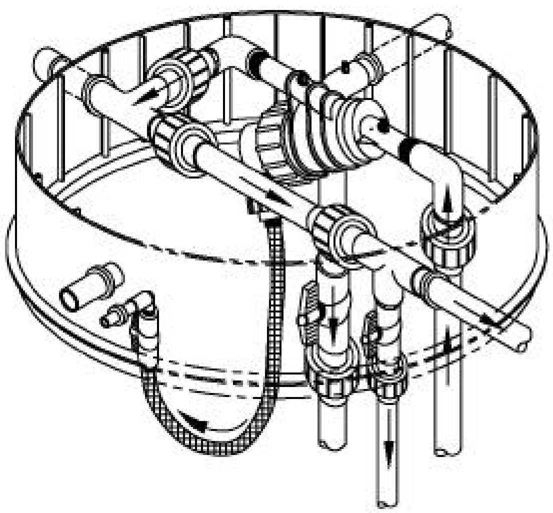
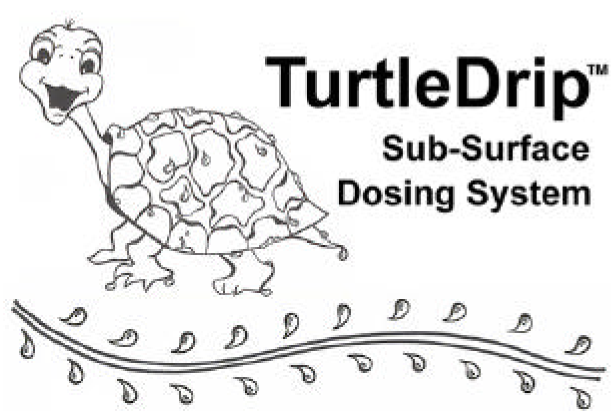


TurtleDrip™ model AQ-200

Wastewater Effluent Management System (WEMS)
Design, Installation, Operation and Maintenance Manual



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Jan 2008

Hydro-*Action*® Industries

TurtleDrip™ WEMS
Design, Installation, Operation and Maintenance Manual
Released February 2004. Updates: January 2004

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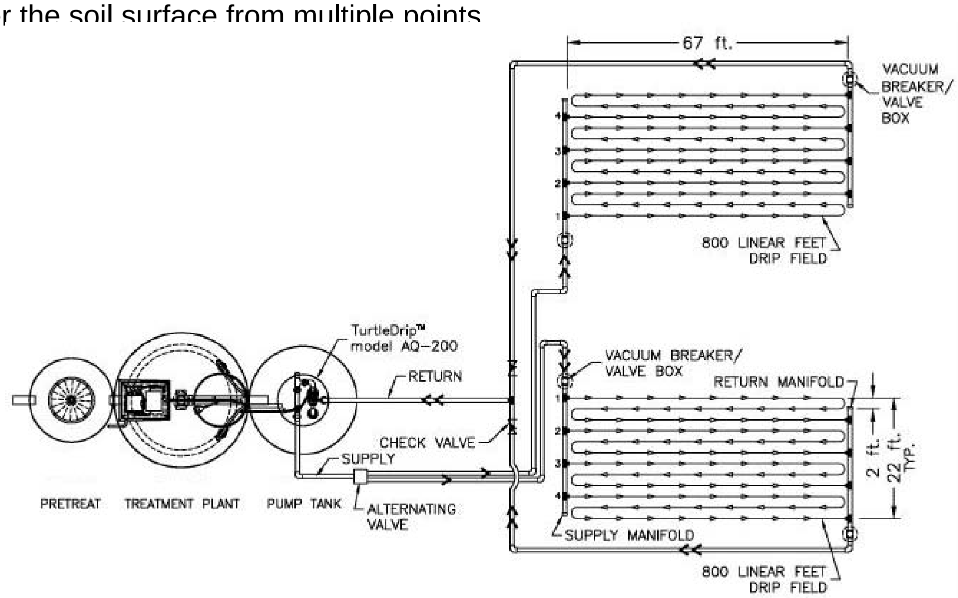
INTRODUCTION

The TurtleDrip™ Wastewater Effluent Management System (WEMS) has been designed to protect and monitor the drip dispersal field. After the wastewater from a home or commercial establishment has been treated in the wastewater treatment plant to less than 30 BOD the WEMS is designed to not only filter the effluent before it is discharged to the drip tubing but it is designed to monitor what is happening within the drip tubing (field) itself, thus providing for a reliable long-lasting drip field installation that will provide years of dependable service for the owner. The TurtleDrip™ utilizes Geoflow's WASTEFLOW® PC drip tubing, which is 1/2" pressurized polyethylene tubing. It is designed utilizing the grid concept with supply and return flush manifolds at each end creating a close loop system. The object with effluent dispersal is usually to disperse the effluent utilizing the minimum area as quickly and safely as possible at an approximately uniform rate throughout the year.

Subsurface drip is a highly efficient method to dispose of effluent. Small precise amounts of water are uniformly applied under the soil surface from multiple points.



The main advantages of a subsurface drip system for effluent dispersal are…

- Human and animal contact with effluent is minimized, reducing health risks.
- Correctly designed systems will not cause ponding or runoff.
- Can be used under difficult circumstances such as high water tables, various soil types, rocky terrain, steep slopes, around existing buildings, trees, or other vegetation and on windy sights.
- Disposal of water is maximized by means of evaporation.
- The system requires no gravel, and is easy to install directly into indigenous soils, maintaining the natural landscape.
- Minimizes deep percolation.
- Consumption of nitrates by plant life is increased.
- Invisible and vandal proof installations.
- Systems are durable with a long expected life.
- Non-intrusive. It allows use of the space while operating.
- Effluent can be re-used for irrigation.

Note: Please follow your state and county regulations for onsite wastewater dispersal. This manual is intended to be a guide to users of the TurtleDrip™ WEMS utilizing Geoflow's drip tubing and should be used only as a supplement to your local regulations.

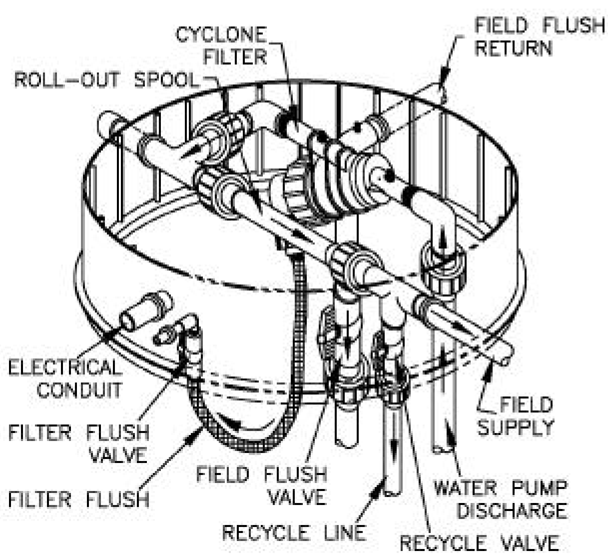
TurtleDrip™ AQ-200 WEMS
Process Description

Raw Domestic Wastewater from a residential dwelling or commercial establishment enters the properly sized wastewater treatment system where it is treated before entering the pump tank. The pump tank is equipped with a properly sized pump and float switches. The float switches in the tank and the micro-dosing timer control this pump mounted in the OPS®, which is part of the TurtleDrip™ model AQ-200 Wastewater Effluent Management System (WEMS). The TurtleDrip™ model AQ-200 is mounted in the 24" riser of the pump tank.

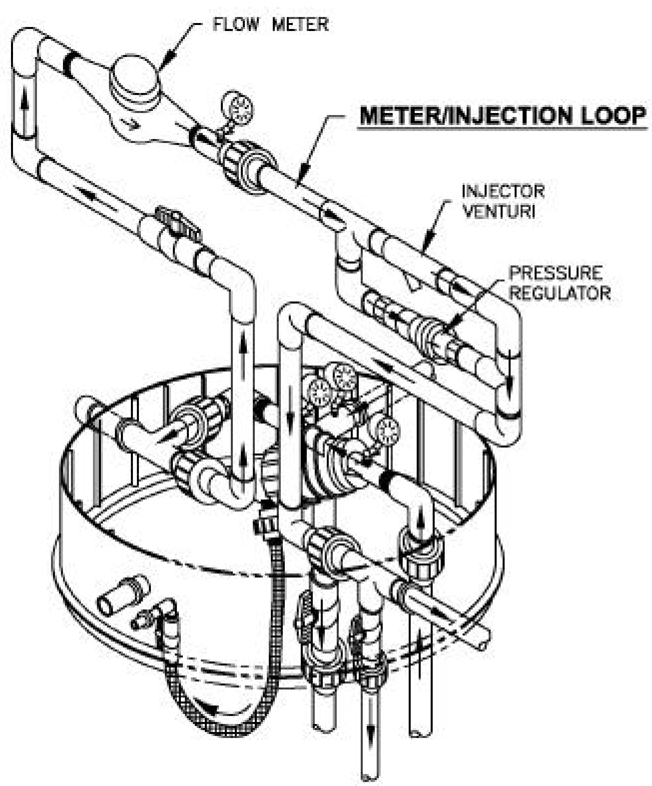
The WEMS model 200 includes a Cyclone Filter, filter flush valve, field flush valve, recycle valve, four schrader valves, seven unions, and associated piping and hose. Also, the Meter/Injection Loop is an important tool to monitor what is happening in the drip field itself and if there is ever a partial plugging, cleaning the drip field and emitters is accomplished with chemical injection.

When the treated effluent level in the pump tank engages the on/off float switch and the micro-dosing timer sends power to the pump, the pump engages, discharging treated effluent into the Cyclone Filter where all particles larger than 100 micron are removed. The filtered effluent then proceeds to the supply header and on to the drip field causing each emitter to emit effluent into the soil with a portion returning to the pump tank via the field flush return.

The effluent re-enters the management system via the field flush valve. This valve is used to control the pressure and the flow in the drip field (7 to 60 PSI, but preferably 10 to 45 PSI as recommended by Geoflow). The field flush valve should be adjusted to maintain a minimum of one gallon per minute through each drip tube run to accomplish a continuous field flush. This field flush is returned to the bottom of the pump tank via a PVC drop pipe. In doing this, particles are never allowed to build in the drip tubing, keeping the field clean. Any trace amounts of particles that enter the pump tank in this way are re-filtered by the Cyclone Filter thus keeping the pump tank clean.



TurtleDrip™ Model AQ-200



Meter/ Injection Loop

Process Description (Cont.)

The Cyclone Filter includes a stainless screen 150 mesh / 100 micron filter element. The self-cleaning action is efficient over a range of flow rates depending on the spin plate selected. The clean-out port is at the base and is equipped with a hose and a filter flush valve. This valve is adjusted to maintain a continuous flush (two gallons per minute) and is piped back to the treatment plant for further treatment.

A recycle valve is included as a part of the management system and is adjusted to maintain Cyclone Filter flows at optimum levels. This recycle is returned to the bottom of the pump tank via a PVC drop pipe. The four schrader valves are positioned such that inlet filter pressure, outlet filter pressure, field supply pressure and field return pressure can be monitored.

So automatically, every time the pump cycles on, the effluent is filtered, the drip field is pressurized, the emitters emit effluent into the soil, each drip tube run is field flushed back to the pump tank, any debris in the filter is flushed to the treatment plant, and to maintain optimum filter flow, a portion of the effluent is recycled back to the pump tank. All of this without any moving valves.

TurtleDrip™ AQ-200 SYSTEM COMPONNENTS

A typical TurtleDrip™ AQ-200 System consists of the following:

1. **AEROBIC TREATMENT SYSTEM**
   a) Properly sized Pre-Treatment tank
   b) Properly sized Aerobic Treatment Plant
   c) OPS® model 50-32 with Micro-dosing timer
   d) Properly sized pump tank

2. **TurtleDrip™ WASTWATER EFFLUENT MANAGEMENT SYSTEM (WEMS)**

   a) **Properly sized water pump**
   TurtleDrip™ requires one of four models (Part #'s below).
   - 100147: 1/2 HP high flow
   - 100154: 1/2 HP high head
   - 100149: 1 HP high flow
   - 100148: 1 HP high head

   b) **Two float switches** (One on/off switch and one high level alarm)

   c) **Model #700010 1-1/2" Cyclone Filter**
   The TurtleDrip™ WEMS uses a self cleaning Cyclone Filter with a stainless screen 150 mesh / 100 micron filter element. The self-cleaning action is efficient over a range of flow rates depending on the spin plate. (Spin plate part #'s below)
   - 702020: 2-hole spin plate
   - 702019: 3-hole spin plate
   - 702018: 4-hole spin plate

   d) **Filter flush valve**
   Used to flush debris from the filter cleanout port back to the treatment tank. This is manually adjusted to maintain one to two gallons per minute.

   e) **Field flush valve and hose**
   Used to maintain a continuous flush of the drip field. This is manually adjusted to maintain a minimum of one gallon per minute per drip tube run.

   f) **Recycle valve**
   Used to maintain proper flow through Cyclone Filter for efficient filter cleaning.

   g) **Four Schrader valves**
   Used to check filter inlet pressure, filter outlet pressure, field supply and return pressure.

   h) **Meter/Injection Loop**
   Used to monitor the flow through the filter and the drip field and inject chemical to clean the drip field.

3. **WASTEFLOW® DRIPLINE**
   WASTEFLOW® dripline carries the water into the dispersal/reuse area. The dripline is connected to the supply and return manifolds with spinlock fittings. In the case of two parallel drip tubes being connected to one another to extend their length, flexible PVC pipe should be used to make the "U" bend. Spinlock fittings are used to make the transition between flexible

PVC pipe and the polyethylene drip tube. Typical spacing between each dripline and between drip emitters is 24" on center. 12" spacing is used regularly for soils with very low or high permeability. The pipe has no joints that may pull apart during installation and is ideal for tractor mounted burying machines. It is sold in 500 ft. rolls. Rolls of alternative lengths, diameters and emitter spacing may be special ordered.

WASTEFLOW® dripline features:

a) ROOTGUARD®

The risk of root intrusion with an emitter slowly releasing nutrient rich effluent directly into the soil is well known to anyone who has observed a leaking sewer pipe. All Geoflow drip emitters are guaranteed to be protected against root intrusion with ROOTGUARD®. This patented process fuses the root-growth inhibitor, TREFLAN® into each drip emitter during manufacturing. Treflan® is registered with the United States EPA for this application. The ROOTGUARD® technology slowly releases Treflan® in minute quantities to prevent root cells from dividing and growing into the barrier zone. It is chemically degradable, non-systemic, and virtually insoluble in water (0.3 ppm). ROOTGUARD® carries a 10 year warranty against root intrusion.

b) Bactericide protection

Geoflow's WASTEFLOW® has an inner lining impregnated with a bactericide, Ultra Fresh DM-50, to inhibit bacterial growth on the walls of the tube and in the emitter. This minimizes the velocity required to flush WASTEFLOW® dripline. With the TurtleDrip™ WEMS, we recommend field flushing at one gallon per minute per drip tube run. This field flush rate coupled with the continuous filter flush of the TurtleDrip™ WEMS prevents biological solids from growing and building up in the drip tube.

c) Turbulent Flow Path

WASTEFLOW® drip emitters are pre-inserted in the tube 6", 12" or 24" apart, with 24" being the most popular. Angles in the emitter flow path are designed to cause turbulence in order to equalize flow between emitters and keep the emitters clean. Geoflow emitters boast large flow paths, which, coupled with turbulent flow, have proven over the years to be extremely reliable and dependable.

d) WASTEFLOW® PC Dripline

WASTEFLOW® PC have turbulent flow path emitters with ROOTGUARD® and bactericide protection. WASTEFLOW® PC has the element of a silicone rubber diaphragm that moves up and down over the emitter outlet to equalize flows regardless of pressure between 7 and 60 psi. To ensure a long life the recommended operating range in 10 to 45 psi.

i) WASTEFLOW® PC can be run long distances.

ii) Steep slopes. Systems should be designed for the dripline lateral to follow the contour.

iii) Rolling terrain. If the difference in height from trough to peak exceeds six feet then WASTEFLOW® PC should be used.

*Vacuum relief valves must be at the top of each rise.

4. **SUPPLY MANIFOLD**

The supply manifold carries the effluent from the dosing tank to the dispersal field. Rigid PVC is used and must be designed to slope back to the pump tank in freezing conditions. The velocity in the manifold should be between 2 ft. per second and 5 ft. per second. Refer to the PVC 40 FRICTION LOSS CHART on page 39 to determine the best diameter for your application.

5. **RETURN MANIFOLD**

The return manifold connects the ends of the driplines together and returns a minimum of one gallon per minute from each drip tube run back to the dosing tank. This provides for continuous flushing of each drip tube run, thus keeping the tubing clean. Rigid PVC is used to accomplish this. The return manifold should be designed to slope back to the pump tank in freezing conditions.

Note: For flow equalization through the drip field, to maintain an even one gallon per minute field flush, the flow equalization technique as seen in the diagram design examples on pages 45-49 should be employed. The first drip tube to leave the supply manifold is the last to enter the return manifold; the last to leave the supply manifold is the first to enter the return manifold.

6. **AIR VACUUM BREAKER**

Air vacuum breakers are installed at the high points to prevent soil from being sucked into the emitters due to back siphoning or backpressure. This is an absolute necessity with underground drip systems. They are also used for proper draining of the supply and return manifolds in freezing conditions. One is used on the high end of the supply manifold and one on the high point of the return manifold. Additional air vents may be required in uneven terrain. Freezing conditions require the air vacuum breaker be protected with insulation.

7. **ZONE VALVES**

Used to divide single dispersal fields into multiple zones. These can be hydraulic activated index valves or solenoid valves. If solenoid valves are used, a properly designed control panel must be used.

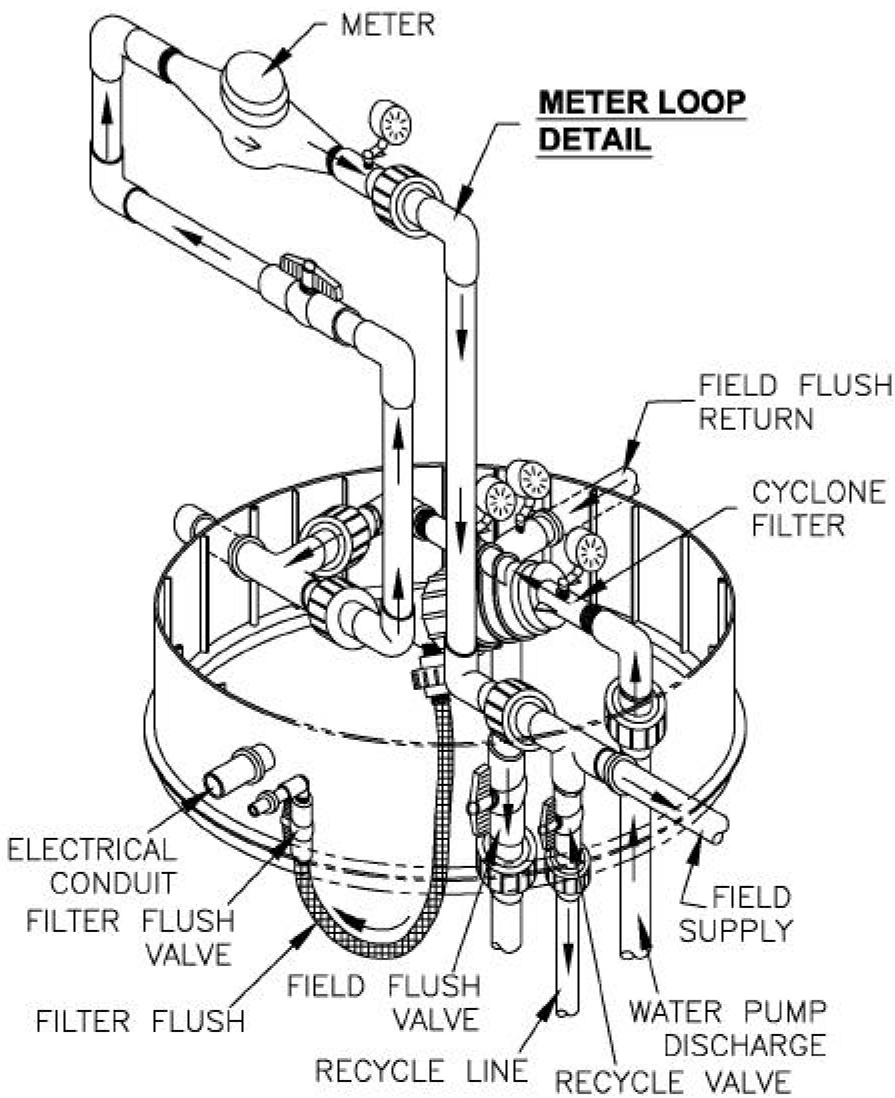
INITIAL START-UP & OPERATION

The TurtleDrip™ Wastewater Effluent Management System (WEMS) has been designed and built to provide dependable service and to protect and monitor the drip dispersal field. For the WEMS to do it's job effectively, however, the treatment system must be installed properly and maintained on a regular basis. To effectively accomplish this, refer to the Hydro-Action® Industries AP-Series Installation Manual and Operation and Maintenance Manual.

ADJUSTING THE PRESSURE AND FLOWS WITHIN THE TurtleDrip™ WEMS & DRIP FIELD

Within the TurtleDrip™ WEMS is everything you need to properly adjust the pressure and flows within the drip field, the Cyclone Filter, the filter flush, the field flush, and to monitor the filter differential pressure, supply and return pressure and to monitor the flows in gallons per minute (gpm) within the entire system. The Meter/Injection Loop is an important tool that is used with the WEMS. After final installation, the meter portion of the tool is connected to the WEMS via a roll-out spool and is used to adjust flows at startup.

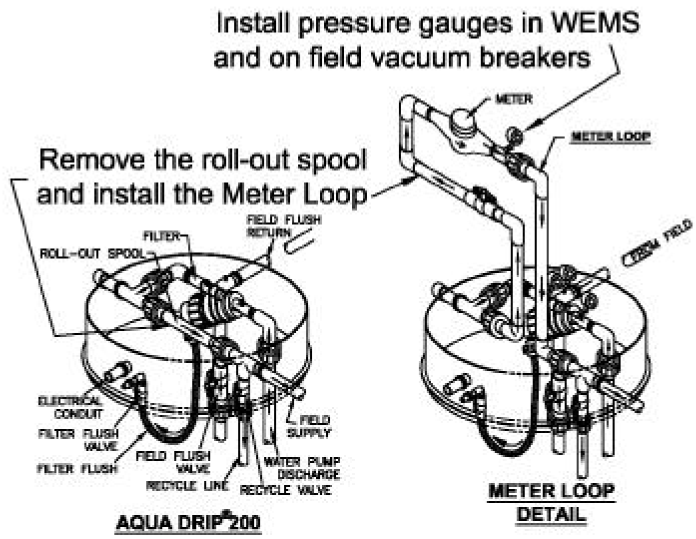
Note: Proper design of the drip field as well as proper pump sizing is essential before flows and pressures can be adjusted.



The following is a step-by-step procedure of adjusting the pressures and flows throughout the WEMS and the drip field after installation. Installation should be complete with the *exception* of gluing the field return at the WEMS and covering open trenches.

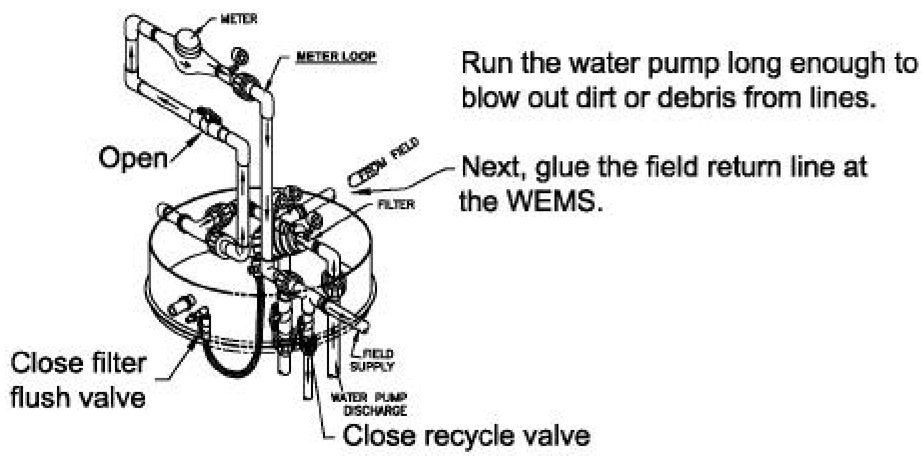
1. **PREPARING FOR SYSTEM START-UP, (INSTALLING LOOP & GAUGES):**

   Remove the roll-out spool from the WEMS and install the Meter Loop portion of the Meter/Injection Loop. Install a pressure gauge with quick chuck on each of the four schrader valves in the WEMS. Pressure gauges with quick chucks can also be installed on vacuum breakers in the field located on the supply and return manifolds thus providing definitive field pressures. Remove valve box cover to install. We are now prepared to monitor field supply pressure, field return pressure, inlet filter pressure and outlet filter pressure (filter differential pressure). We can also monitor the flow dripping from the emitters, field flush, filter flush and flow through the filter all in gallons per minute (gpm). Note: For flow monitoring procedures, refer to page 17.



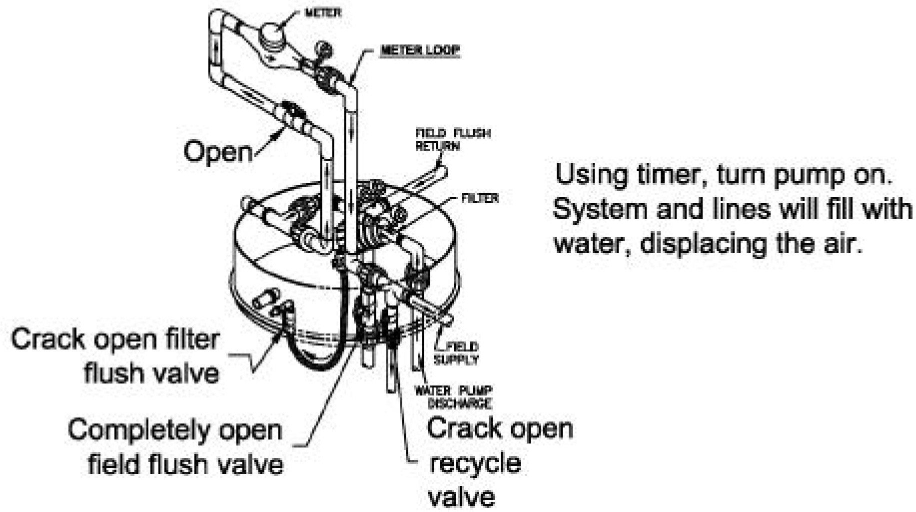
2. **BLOWING OUT DEBRIS**

   Close recycle valve and filter flush valve and fill the pump tank with enough water to engage the water pump. Run the water pump (pump on/off float should be covered with water and manually engage the micro-dosing timer in the OPS) long enough to blow any dirt or debris out of the drip field and supply and return manifold that may have entered during installation. Turn the pump off (manually disengage the micro-dosing timer) and glue the field return at the field flush line of WEMS.



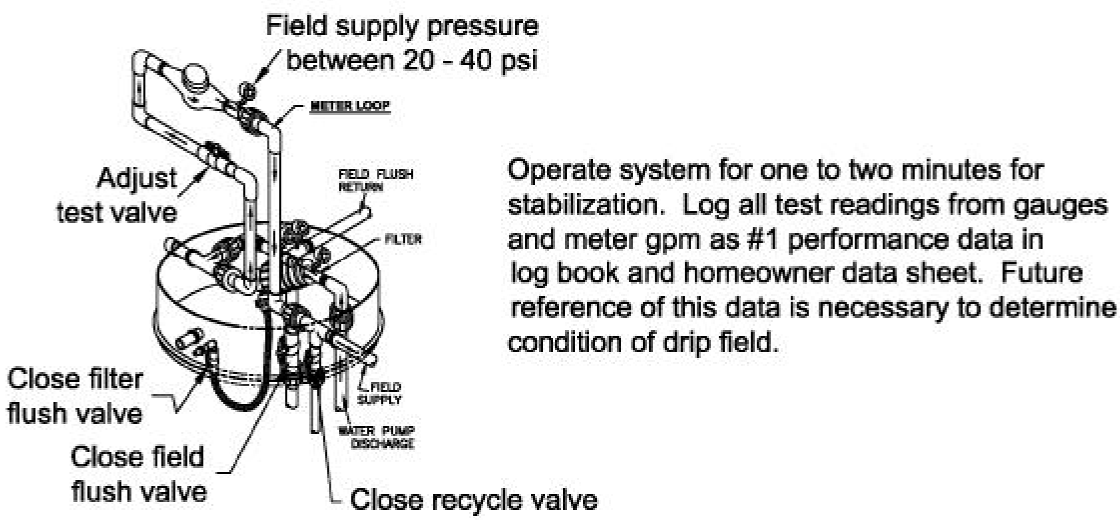
3. AIR DISPLACEMENT:

Completely open field flush valve, crack open filter flush valve and recycle valve. Using the micro-dosing timer, engage the pump. The pump will displace the air and fill the filter, supply manifold, drip field and return manifold. *(For timer setting, see page 28.)*



4. #1 PERFORMANCE DATA: (FIELD TEST)

Once all air is displaced, close field flush valve, filter flush valve, and recycle valve. Adjust test valve on Meter Loop to achieve a desired pressure between 20 to 40 psi. on Meter Loop gauge. This pressure reading reflects field supply pressure. Operate in this manner for one to two minutes to stabilize system. The service provider should log the pressure and the meter reading in gpm (#1 performance data) in the maintenance logbook and homeowner data sheet. *Note: For flow monitoring procedures, refer to page 17*.
This will give the service provider the start up performance data of the new and clean drip field. When service provider performs future routine inspection and service, this same measurement can be taken to determine the condition of the drip field. Refer to "ROUTINE INSPECTION & MAINTENANCE" section, page 14 for more details on tracking the fields condition.



5. ADJUSTING SYSTEM FOR NORMAL OPERATION: (See diagram 5.6. on next page)

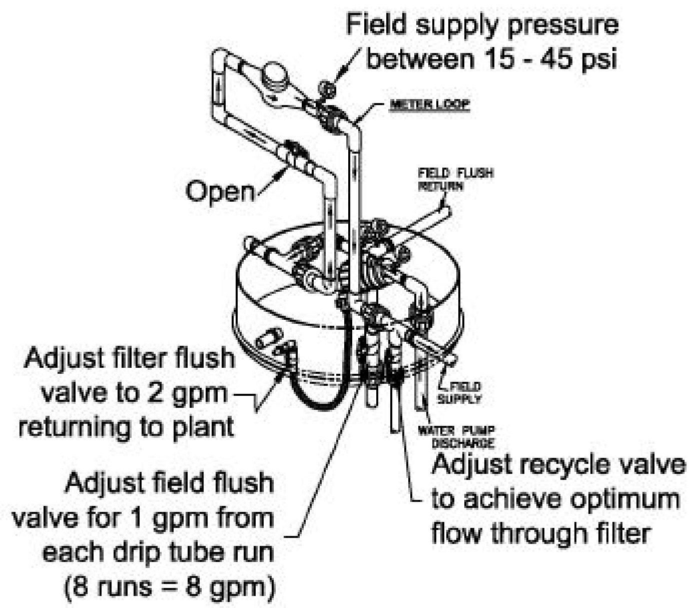
To do this, simultaneously adjust field flush valve, recycle valve and filter flush valve. *Note: test valve on Meter Loop should be completely open.* Pressure should be maintained in the field at the recommended range of 10 to 45 psi. (While completing flow and pressure adjustments of system, periodically check all connections in the drip field for leaks). Flow returning from field through field flush valve should be physically measured to provide for a minimum of one gallon per minute from each drip tube run. (To do this remove Pvc drop-pipe and measure with incremented container. Adjust filter flush valve to achieve 2 gallons per minute. *(Note: On drip fields where total flow dripping from emitters is less than 4 GPM, filter flush should be adjusted to one GPM)*. Reading effluent meter in gpm and adding filter flush measurement will provide the total flow through the filter itself in gallons per minute. *Note: For flow monitoring procedures, refer to page 17.* Filter flow should be maintained within optimum flow ranges to provide for proper cleaning of filter. *Note: Adjust recycle valve to bring filter flow within optimum range; this will lower pressure within the system and drip field. It may be necessary to operate field at low end of pressure requirements to achieve this.* Filter will be equipped with a two, three, or four hole spin-plate, depending on field design and pump sizing. For optimum flow ranges of different spin-plate sizes refer in "DESIGN" Section, on page 40. Achieving these pressures and flows will require some diligence and back and forth adjusting of the valves.

Note: *Changing the position of one valve will change pressure and flows somewhat throughout the system.*

5.6. Adjusting system for normal operation (#2 Performance Data)

Meter gpm + 2 gal. filter return = total flow through filter.
Adjust recycle valve for optimum flow through filter.

Once adjusted, log all pressures, meter reading & filter/ field flush flow gpm in log book and homeowner data sheet as #2 Performance Data.

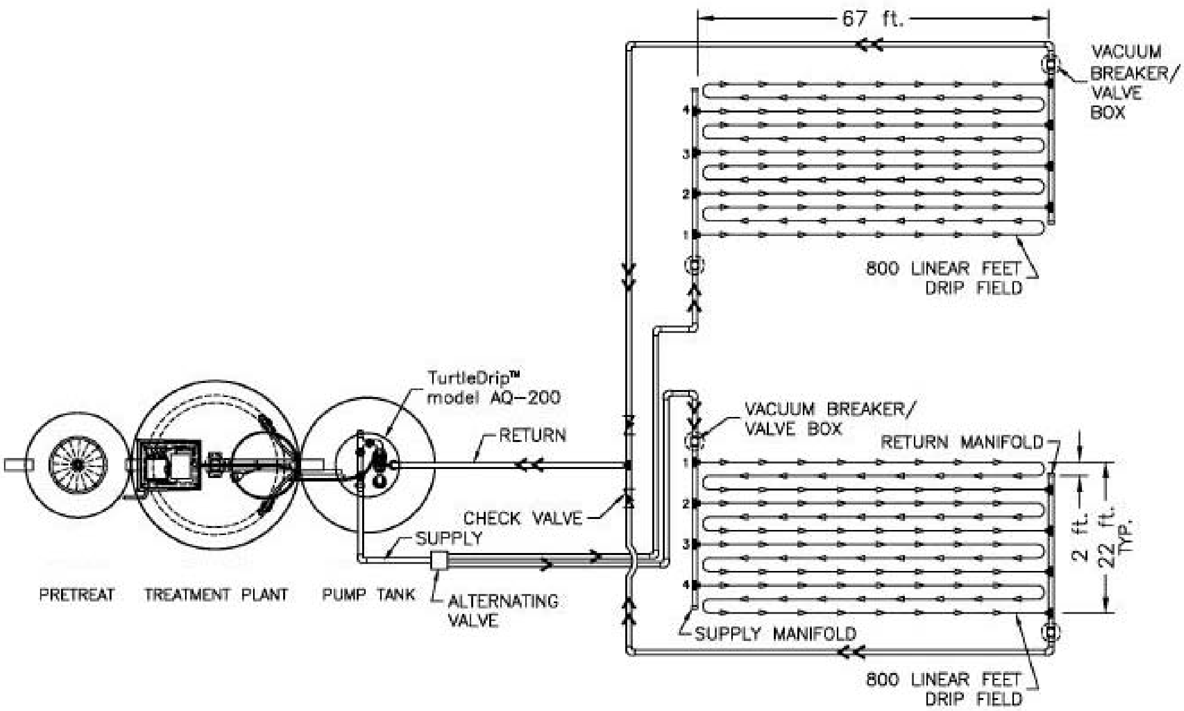


6. **#2 PERFORMANCE DATA: (See diagram 5.6. above)**
   After pressure and flows have been adjusted, the service provider should log the pressures, the meter reading, field flush flow, and filter flush flow in gallons per minute (gpm) in the maintenance logbook and homeowner data sheet (#2 performance data). Turn the pump off and return the system to normal operating mode. Upon finding no leaks in the field, cover any open trenches.

7. **POSITIONING VACUUM BREAKER HOLES: (See diagram 7.9.10. on next page)**
   The field flush line and the recycle line have drop-pipes that divert the effluent to the bottom of the pump tank. These drop-pipes have 1/8" vacuum breaker holes located below the union, & should be positioned such that under pressure they spray toward the tank wall.

8. **MULTIPLE FIELDS: (See diagram next page)**
   In the event the drip dispersal system contains multiple fields utilizing the same WEMS and an alternating valve, step 4 (#1 Performance Data) must be performed for each field and logged accordingly.

Note: It is recommended that fields should be designed identical if possible. If this cannot be accomplished due to site conditions, secondary fields should have less but not less than 400 lineal ft. of drip tubing than the main drip field. Management system pressures and flows should be adjusted for normal operation of the main drip field as explained in step 5. It is acknowledged that secondary field pressures and flows will be slightly altered but will remain within tolerance levels.



9. SECURING SITE:

Remove the Meter Loop and replace it with the roll out spool. Remove the four pressure gauges and replace them with the schrader valve caps. Place lid on riser and secure properly with security screws. If pressure gauges were used in field on vacuum breakers, remove these and replace valve box covers.

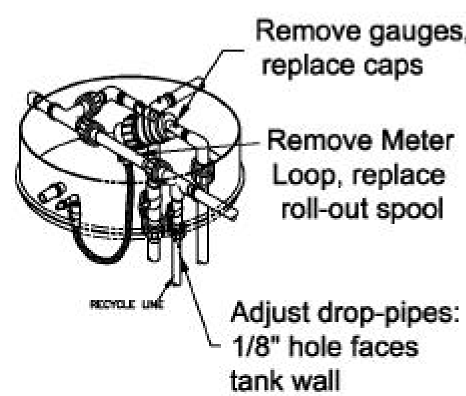
10. PROVIDING HOMEOWNER INFORMATION:

Provide owner with final as-built diagrams, flow measurements and pressure readings (#1 & #2 performance data).

7.9.10. Finishing up & securing site

Pump is off and system is in normal operating mode.
Replace lid with security screws.

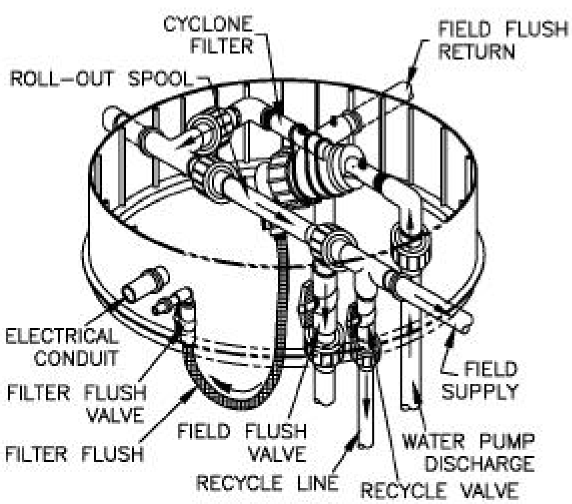
Provide owner with final diagrams and performance data.



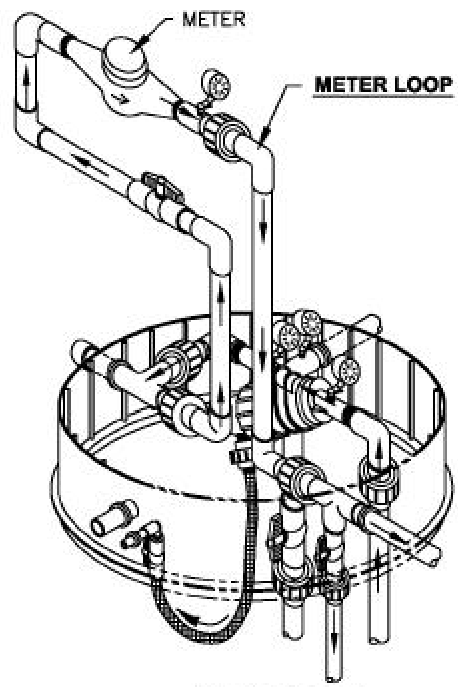
ROUTINE INSPECTION & MAINTENANCE
(Check #2 data, check #1 data)

Although the TurtleDrip™ Wastewater Effluent Management System (WEMS) is totally automated, routine inspection and preventative maintenance will ensure years of trouble-free operation for your entire system, including the drip dispersal field. When the service provider services the effluent ®treatment system, usually every six months, (refer to Hydro-Action® Industries AP Series Operation & Maintenance Manual for service required to treatme ® treatment system) routine inspection and preventative maintenance should be performed on the TurtleDrip™ WEMS and drip field.

Check & Record #2 Performance Data: Remove the WEMS cover and valve box covers over vacuum breakers in the drip dispersal field. Remove roll-out spool and install Meter Loop. Remove schrader valve caps and install pressure gauges in WEMS and on vacuum breakers in field. Engage the water pump by manually controlling the micro-dosing timer in the OPS®. Read pressures and the meter. Measure field flush and filter flush. They should be the same as the pressures and flows written in the logbook when the system was first started up (#2 Performance Data). If filter differential pressure has increased, or #2 Performance Data has changed, shut pump down, remove filter screen, clean and replace. Record #2 Performance Data (along with the date of service call) in the logbook.



TurtleDrip™ Model AQ-200



Meter Loop Detail

Check & Record #1 Performance Data: Close field flush valve, filter flush valve and recycle valve. Adjust meter loop valve until field supply line pressure within the WEMS is the same as recorded logbook start-up pressure (#1 Performance Data). Read the meter and record in logbook. It should be the same as start-up #1 Performance Data.

If the meter reading is the same as it was at start-up (#1 performance data) or has less than a 20% variance, WEMS and drip dispersal field are performing within an acceptable range. In this case, set WEMS back to the last recorded #2 Performance Data for normal operation. Remove meter loop and gauges; replace roll-out spool, and secure the site.

However, if the meter reading for #1 Performance Data has a variance of 20% or greater, partial plugging of the emitters has occurred. It is time to restore the drip dispersal tubing. Refer to "RESTORING DRIP TUBE PERFORMANCE" Section on page 15. With accurate monitoring, service provider should be able to foresee a greater than 20% variance, and discuss the necessary restoration procedure with the homeowner.

RESTORING DRIP TUBE PERFORMANCE – CHEMICAL INJECTION

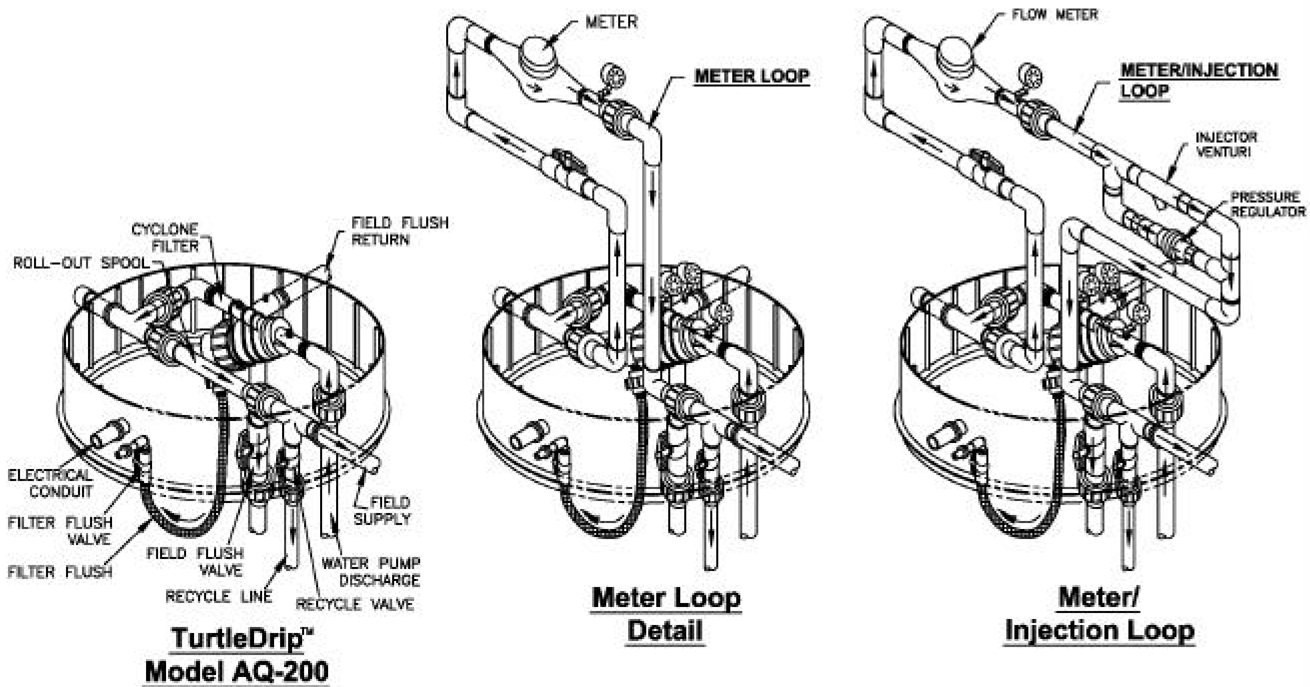
Restoring the drip tubing will require the injection of a chemical that will dissolve the organics within the drip tubing and the emitters and be compatible with the PVC supply and return piping and with the polyethylene drip tubing. (Use high strength chlorine, hydrogen peroxide, etc.) The environmental site should be taken into consideration when selecting an injection chemical.

Components required to accomplish the chemical injection are as follows:

1. Meter/Injection Loop
2. Field flush (disposal) hose
3. Disposal drum
4. Injection chemical and dilution container

Once it has been determined that restoration of the drip tubing is necessary, install the Meter/Injection Loop. Next, install the field flush disposal hose. This is done by removing the field flush drop pipe and connecting a hose to the 1 1/4" union down stream of the field flush valve and routing the hose out of the pump tank and into your disposal drum. Position the chemical dilution container near the Meter/Injection Loop. Add chemical at proper strength to the dilution container. Place injector venturi suction tube into container. The proper amount of chemical will need to be injected into the drip field so that the drip tubing and the emitters are full of chemical. To accomplish this, two methods can be used:

1. Calculate the amount of chemical in gallons that the drip field will hold.
2. Add trace dye in the chemical itself.



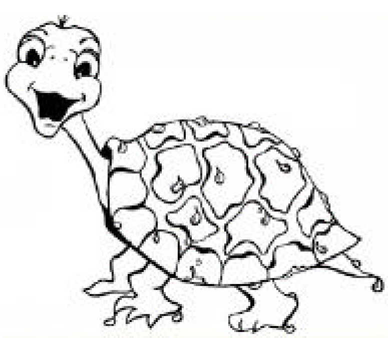
After chemical has been added to dilution container and injector venturi tube is in place you are now ready to start the injection process. To do this, **completely close the recycle valve** and fully open the field flush valve (the filter flush valve can remain in normal position) then start the water pump. Effluent will be discharged through the cyclone filter, meter, and injector venturi where high strength chemical will be added to the effluent stream before leaving the WEMS and entering the drip tubing. The chemical solution will then return to the WEMS through the field flush valve and disposal hose and on to the disposal drum *(not into the pump tank)*. The meter will allow monitoring of the desired amount of chemical to the drip tubing. Once the drip tubing is full of chemical solution and is returning to the disposal drum, close field flush valve and wait for **60 seconds** allowing chemical solution to permeate

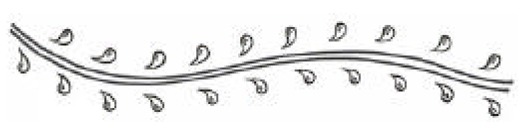
RESTORING DRIP TUBE PERFORMANCE (CONT.)

the drip emitters. Turn off water pump and wait **45 minutes** to allow the organics to be broken down in the drip tubing and the emitters. Remove injector venturi from dilution container.

Before re-engaging the water pump, open the field flush valve completely. Engage the water pump allowing the dissolved organics to be flushed into the disposal drum and *not* out the emitters. Monitor the flush back to the disposal drum. At first the solution will be dark and murky. When the solution has completely cleared up, close the field flush valve. This will allow the pressure to build in the drip field, which will flush the dissolved organics in the emitters into the soil.

To see if the drip tubing has been fully restored, follow procedures in "ROUTINE INSPECTION & MAINTENANCE" Section, page 14 (check #1 Performance Data). If tubing has not been fully restored, repeat restoration steps above.





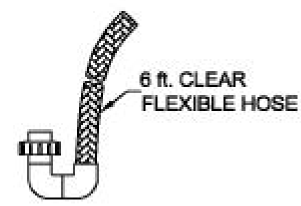
FLOW MONITORING PROCEDURES

1. Monitoring flow with the effluent meter

a) Water pump must be engaged, and WEMS adjusted to the desired parameters.
b) Using stopwatch, start time when red pointer is at 0. (Write down or make a mental note of counter start point)
c) After 60 seconds, note red pointer position and counter reading.
d) The difference between (b) and (c) will give you total gallons per minute.

2. Measuring field flush flow in GPM

a) With effluent pump off, disconnect field flush drop pipe within WEMS and connect field flush hose.
b) Direct field flush hose discharge back into pump tank and start effluent pump. Place field flush hose into measuring container and with stopwatch, measure to determine flow in gallons per minute.



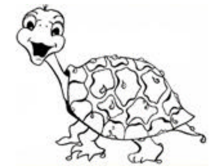
FIELD FLUSH HOSE

<u>EXAMPLE ONE</u>:
Remove flush hose after 60 seconds and measure amount of effluent in container. This will give you GPM.
<u>EXAMPLE TWO</u>:
Remove flush hose after 15 seconds and measure amount of effluent in container. Multiply the amount by four. This will give you GPM.

3. Measuring filter flush flow in GPM

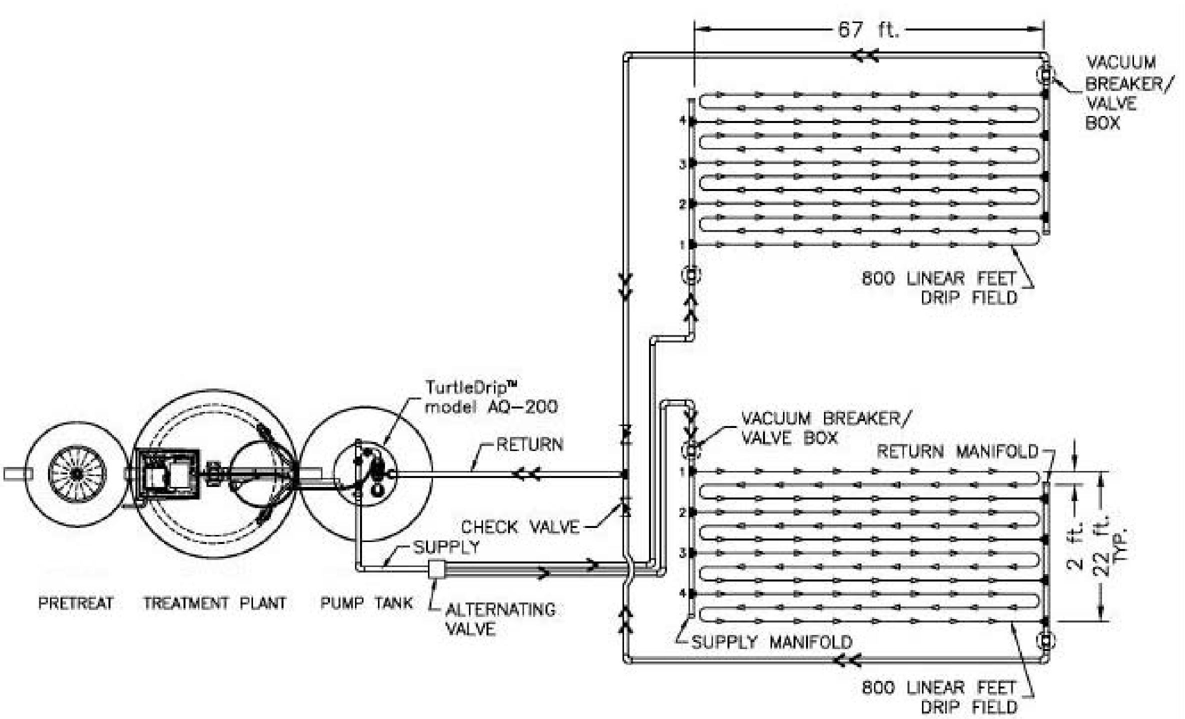
a) With effluent pump running, place one-gallon measuring container under discharge in treatment plant access riser.
b) Adjust flow with filter flush valve to achieve two GPM. To do this, fill one gallon container in 30 seconds. (Use a stopwatch)

Note: On drip fields where total flow through drip emitters is less than 4 gpm, adjust filter flush to one gallon per minute. In this situation, filling a one-gallon container in 60 seconds will accomplish this.



SYSTEM INSTALLATION

The TurtleDrip™ WEMS is mounted in the pump tank of the treatment system. For installation of the treatment system, refer to the pertinent installation manual. When you have installed the system, you have installed the management system. All that is left is to install the drip dispersal field and connect the field supply and return lines to the WEMS.



The TurtleDrip™ WEMS utilizes Geoflow WASTEFLOW® PC Drip Tubing. Handle the drip tubing and components with care. ROOTGUARD® is temperature sensitive. To assure a long life, store the drip line out of direct sunlight in a cool place. This should be a consideration when installing the system in very hot and sunny areas. Your system life span will be increased if it is buried an extra 2 – 3 inches below the soil surface to avoid the warm temperature extremes.

1. All drip field construction should be done in accordance with local rules and regulations.
2. No utilities, cable wire, drain tile, etc. shall be located in the drip field.
3. Fence off entire drip field prior to any construction.
4. System is not to be installed when ground is wet or frozen.
5. Divert all down spouts and surface waters away from drip field or into curtain drains.
6. Excavation, filling and grading should have been finished before installation of the subsurface drip system.
7. Be sure you have everything required for the installation before opening trenches. Pre-assemble as many sets of components as practical above ground and in a comfortable place. Slip-lock adapters should be glued to PVC tees, the supply and return manifolds with tees can be pre-assembled and used to mark the beginning and end of WASTEFLOW® lines.
8. For particularly tough soil conditions, moisten the soil the day before opening trenches or installing WASTEFLOW®. Remember it is much easier to install the system in moist soil. The soil should be moist but still should allow the proper operation of the installation equipment and not cause smearing in the trenches. The soil surface should be dry so that the installation equipment maintains traction.
9. Mark the four corners of the field. The top two corners should be at the same elevation and the bottom two corners should be at a lower elevation. In freezing conditions the bottom dripline must be higher than the supply and return line elevation at the pump tank.

10. Install a watertight pump tank. In freezing conditions the pump tank should be at the lowest elevation of the entire system.
11. Determine the proper size for the supply and return manifolds. Refer to page 25.
12. Install the PVC supply line from the pump tank, up hill through one lower and one upper corner stake of the dispersal field. Please refer to your state guidelines for depth of burial.
13. Paint a line between the two remaining corner stakes.
14. Install the Geoflow WASTEFLOW® dripline from the supply line trench to the painted line, approximately 6” to 10” deep as specified. *Note: Some drip field designs will require supply and return manifolds to be on the same side of drip field. In this case, flexible PVC U-bends will be required to connect individual drip tube runs.* Upon reaching the painted line, pull the plow out of the ground and cut the dripline 1’ above the ground. Tape the end of the dripline to prevent debris from entering. Continue this process until the required footage of pipe is installed. Geoflow dripline must be spaced according to specification (2 ft. is standard). Depth of burial of dripline must be consistent throughout the field. Take care not to get dirt into the lines.

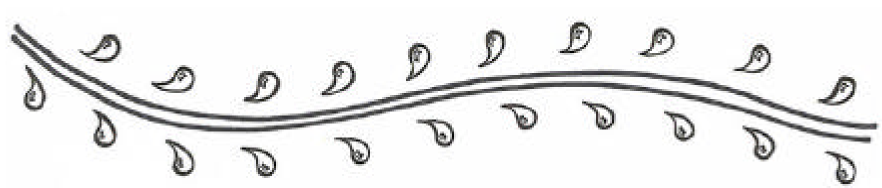
    <u>Installing flexible PVC U-bend assembly</u>

    Note: Do not bend polyethylene drip tubing in a “U” shape as kinking can occur.

    a. Using flexible PVC piping (same diameter as tubing), cut to the proper length to form a U-bend to connect two drip tubes together.
    b. Glue a PVC adapter to each end of PVC U-bend
    c. Using Teflon tape on slip-lock fitting threads, connect to PVC adapter.
    d. Connect U-bend assembly to drip tubing.
15. Install the supply header with tees lined up at each Geoflow line. Hook up the Geoflow lines to the supply header. Do not glue WASTEFLOW® dripline.

    <u>Install slip-lock fittings</u>

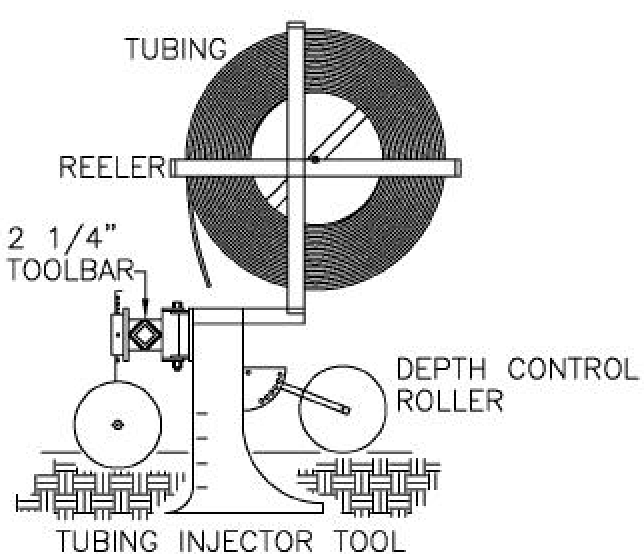
    a. Hold the fitting in one hand and position the tubing with the other hand.
    b. Move the sleeve back, and push the tubing onto the exposed stem as far as possible.
    c. Push the sleeve out over the tubing and thread the sleeve onto tubing, as though tightening a nut to a bolt. Hand tighten. Do not use tools.
16. Dig the return manifold ditch along the line painted on the ground and back to the pump tank. On designs requiring supply and return manifolds to be in the same ditch, use painted line ditch for PVC U-bends. Start the return manifold at the farthest end from the pump tank. The return line must have slope back to the pump tank.
17. Install the return manifold and connect all of the Geoflow lines. Care must be taken not to kink the dripline.
18. Install air vacuum breakers at the highest points in the dispersal field. Use pipe dope or Teflon tape and hand tighten.
19. Connect the supply line to the TurtleDrip™ WEMS. Refer to “INITIAL START-UP & OPERATION” Section, pages 9-13 to proceed.



SUBSURFACE DRIP INSTALLATION METHODS

Note: Disturbing the soil may effect the pore structure of the soil and create hydraulic conductivity problems. Please consult with your soil scientist or professional engineer before making the installation technique decisions.

INSERTION METHOD	ADVANTAGES	DISADVANTAGES
a) Hand Trenching	■ Handles severe slopes and confined areas ■ Uniform Depth	■ Slow ■ Labor intensive ■ Disrupts existing turf and ground ■ Back fill required
b) Oscillating or vibrating plow. Use the type that inserts the dripline directly in place, not one that pulls the dripline through the soil.	■ Fast in small to medium installations ■ Minimal ground disturbance ■ No need to back fill the trench	■ Depth has to be monitored closely ■ Cannot be used on steeper slopes (>20%) ■ Requires practice to set and operate adequately ■ Tends to “stretch” pipe. Shorter runs are required.
c) Trenching machine	■ Faster than hand trenching ■ May use the 1” blade for most installations ■ Uniform depth	■ Slower, requires labor ■ Disrupts surface of existing turf ■ Back fill required
d) Tractor with dripline insertion tool – see diagram below.	■ Fast ■ Little damage to existing turf because of the turf knife ■ Minimal ground disturbance ■ Does not stretch drip line ■ Adaptable to any tractor	■ The installation tool is designed specifically for this purpose.
e) Tractor mounted 3-point hitch insertion implement	■ Fastest. Up to four plow attachments with reels ■ A packer roller dumps back soil on top of the pipe	■ Suitable for large installations only



WINTERIZATION

Buried drip systems are not prone to frost damage because, in their design, vacuum release and drain valves are provided. The dripline itself is made of polyethylene and not susceptible to freezing. It drains through the emitters so will not be full of water after pumps are turned off. Please follow these precautions:

1. Manifolds, supply lines and return lines must be sloped back to the pump tank. These lines need to drain rapidly. Under extreme conditions return and supply manifolds must be insulated or buried below frost line.
2. There should be no check valve at the pump.
3. Insulate WEMS, including zone dosing valves and air vacuum relief valves. Use closed-cell insulation such as Perlite in a plastic bag.
4. In severe freezing conditions, use heat tape for zone dosing valves and air vacuum relief valves.
5. The top of air vacuum relief valves must be no higher than soil surface.
6. Using an index valve to split field zones, be sure it is capable of self-draining.
7. WASTEFLOW® lines will self-drain through the emitters into the soil. If the cover crop over the drip field is not yet adequately established, add hay or straw over the field for insulation.
8. Mark the valve box with a metal pin so you can find it in the winter when covered in snow.
9. Fields dosed with relatively small quantities of effluent are more likely to freeze than those dosed with design quantities. If winter use is less than summer use, then only use proportional number of fields to maintain water application rates in the field being dosed.

SYSTEM DESIGN

Overview of designing the entire drip system

Designing the drip system requires selecting the proper equipment, designing the drip field, and correlating it all to work well together. The following is a step-by-step overview of accomplishing this.

1. **Selecting the proper treatment system.**
   a. Select the size of the pretreatment tank.
   b. Select the size of the wastewater treatment plant.
   c. Select the size of the pump tank.
   Note: Refer to your state or local regulations.
   d. Select the proper OPS (Operations Control Center). There are two models available, model 50-32 and 50-32A.
   Model 50-32: Select when using 1/2 HP pumps.
   Model 50-32A: Select when using 1 HP pumps.
   e. Specify the addition of the model AQ-200 Wastewater Effluent Management System (WEMS). This will be added to the pump tank and incorporated into a 24" riser. This WEMS model will function properly with flow rates between 2 and 50 GPM.
   f. Select the proper spin plate for the Cyclone Filter in the WEMS. To do this, refer to page 40.
   g. Select the proper pump size. Four pump sizes are available. Refer to the chart on page 26 & 27.
2. **The proper drip tubing.**
   a. WASTEFLOW® PC with pressure compensating emitters.

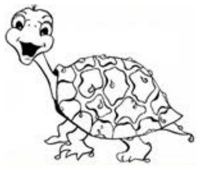
   WASTEFLOW® PC can be used with all elevations. Emitters range in flow generally between 1/2 to 1 gallon per hour. Emitter spacing is normally 2 feet but 1 ft. and 18" can be used for specific site conditions.
   Refer to pages 34-36.
   b. Evaluate the site and determine where the drip field(s) will be placed.
   When elevation in a drip field zone exceeds 6 feet, WASTEFLOW® PC should be used as it can tolerate very large height variations.

   c. Evaluate the soil to determine emitter flow range and spacing. In sandy, loamy and non-swell clay soils, 2 ft. emitter spacing and either 1/2 or 1 gph flow range is acceptable. In heavy clay soils or very coarse sand where lateral movement of water is restricted, emitter spacing of 1 ft. and either 1/2 or 1 gph flow range is used.
   Note: Refer to pages 30 & 31.
3. **Designing the drip field:**
   a. Select the area with careful consideration of the soil, the terrain and your State and County regulations. Be sure the field is not in a flood plain or bottom of a slope where excessive water may collect after rain. Surface water should be directed away from the proposed field area.
   b. To calculate the area required for your drip dispersal system, you must know the quantity of effluent to be disposed of (in gallons per day) and the soil type. Use WORKSHEET 1 on page 24 to determine hydraulic loading rate; total area required in the drip field; emitter number, spacing and flow range; linear footage of drip tubing; type of drip line; pressure in drip field; total flow to drip field in gpm; and size of manifolds.
   c. Once this has been determined, sketch out the drip field keeping in mind that it has to fit the site selected and that each drip tube run should be the same length to assure uniform field flushing. Refer to pages 35-36 to determine individual drip tube run

lengths. Keep the runs as long as possible to minimize the quantity of field flush effluent required. This is especially important in large drip fields where the pump selected is being maximized. For sample drip field designs, refer to pages 44-45.

d. Designing for flow equalization within the drip field. Each drip tube run should be the same length although one run can have more “U” bends than another. Follow the flow from the pump tank through the supply line and into the drip field and back to the pump tank via the return manifold. You will notice that the first drip tube run to leave the supply manifold is the last to enter the return manifold. You will also notice that the last drip tube run to leave the supply manifold is the first to enter the return manifold. Following these guidelines assures equal flow through the entire drip field, which is important for efficient field flushing. Supply and return manifolds may be at each end of the drip field or on the same end of the drip field depending on the layout of the drip tube runs.

Note: “U” bends should be made with flexible PVC pipe, not the drip tubing.



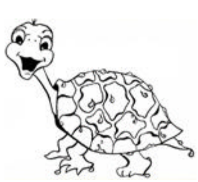
WORKSHEET 1 - DISPERSAL FIELD DESIGN FOR MULTIPLE ZONE SYSTEMS

Worksheet	Formula
A) Quantity of effluent to be dispersed per day ___________________ gpd	*Minimum of two zones required* *(GPD) divided by # of zones = A*
B) Soil type and hydraulic loading rate *i*_____________ *soil type* *ii* _____________ *hydraulic loading rate (gal/sq.ft./day)*	*Based on soil analysis.* *Refer to State or Local regulations.* *If none, refer to Table 1, page 30.*
C) Determine the total Area required in each drip field ____________________ *square ft*	*Divide gpd by hydraulic loading rate per zone. (A)/(Bii)*
D) Choose the spacing between each WASTEFLOW® line and each WASTEFLOW® emitter *i.* ____________________*ft. between WASTEFLOW® lines* *ii.* ____________________*ft. between WASTEFLOW® emitters*	*Standard spacing is 2 ft.*
E) How many linear feet of dripline in the total area? *Note: Round up to the nearest equal number which allows for each drip tube run in the field to be the same.* ___________________ft.	*(Area / 2) for 2ft. line spacing. (C)/2.0 or* *(Area / 1) for 1 ft. line spacing. (C)/1.0 or* *(Area / 0.5) for 6” line spacing. (C)/0.5*
F) Calculate the number of emitters ___________________emitters	*(Linear ft. of dripline/2)for 2 ft emitter spacing. (E)/2 or* *(Linear ft. of dripline/1)for 1 ft emitter spacing. (E)/1 or* *(Linear ft. of dripline/0.5)for 6" emitter spacing (E)/0.5*
G) Pressure compensating dripline ❑ *WASTEFLOW® PC dripline*	*See pages 34-36*
H) Determine Drip field pressure ____________________ *psi*	*Standard pressure is 17 psi.* *WASTEFLOW® PC systems need between 15 and 45 psi (23.1 ft. to 104 ft.) at the start of the drip field.*

WORKSHEET 1 CONT. ON NEXT PAGE

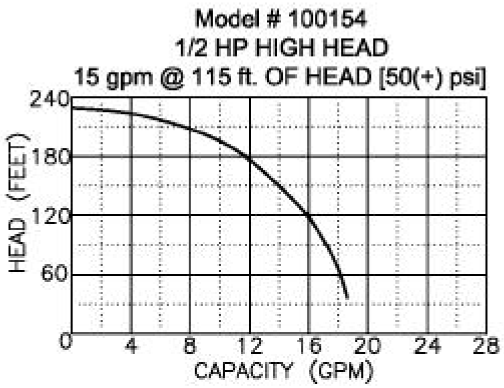
WORKSHEET 1 (cont.)

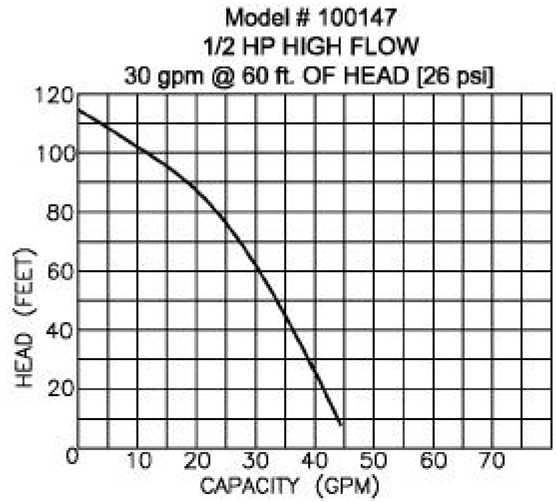
I) Determine feet of head required at drip field ___________________ *ft. of head*	*Multiply drip field pressure (H) on page 24 by 2.31 to get head required.* *(H) x 2.31*
J) What is the flow rate per emitter? ______________*gph / emitter*	*See WASTEFLOW® PC specification chart, page 35-36.*
K) Determine total drip emitter flow for the field __________________*gph* __________________ *gpm*	*Number of emitters (F) multiplied by the flow rate per emitter (J) = total flow in gallons per hour. Gallons per hour divide by 60 = gallons per minute.* *Gph = (F) x (J) Gpm = gph/60*
L) Determine total flow for field flush __________________ *gpm*	*Calculate one gallon per minute for each drip tube run. This should be done after design is complete.*
M) Figure two gallons per minute for filter flush	
N) Minimum pump capacity not including recycle __________________ *gpm*	*Add (K) (L) & (M) together to get minimum pump capacity which will not include any recycle.*
O) Select pipe diameters for manifolds and submains ___________________*inche(s)*	*Add (K) & (L) together to get total flow in gpm.* *See schedule 40 friction loss charts on page 38.* *Optimum velocity is between 2 and 5 ft. per second.*

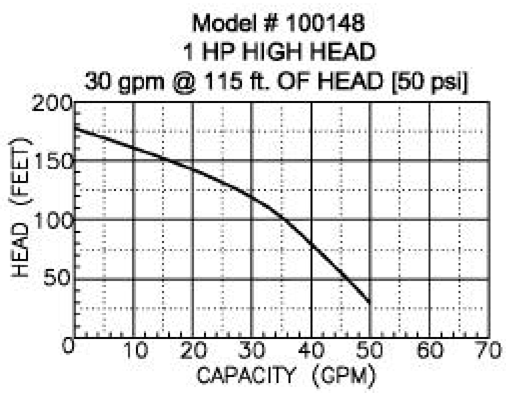


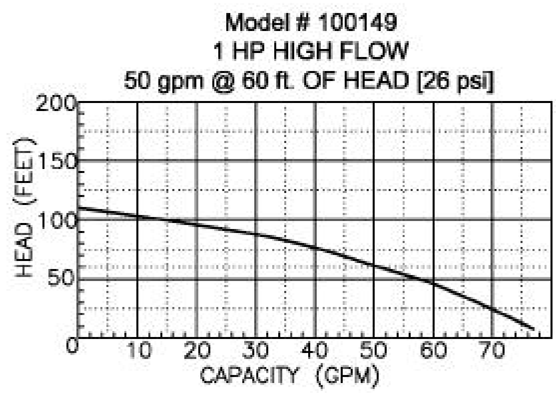
WORKSHEET 2 – PUMP SELECTION

Hydro-Action offers four pump models for it's TurtleDrip™ to meet the varying demands of different site conditions and drip field sizes; a 1/2 HP high head 15 gpm pump, a 1/2 HP high flow 30 gpm pump, a 1 HP high head 30 gpm pump, and a 1 HP high flow 50 gpm pump. Below are the pump curves. Use pump curves along with Worksheet 2 to select pump.









Worksheet 2 (PUMP CALCULATIONS)		Formula
P) Minimum pump capacity not including recycle	____________gpm	*From (N) above*
Q) Header pipe size	____________inches	*From (O) above*
R) Pressure loss in 100 ft. of pipe	____________psi	*Refer to PVC charts on page 38.*
S) Friction head in 100 ft. of pipe	____________ft. of head	*Multiply psi from (R) above by 2.31*
T) Static head		
i) Height from pump discharge to tank outlet	____________ft.	*Number of ft.*
ii) Elevation increase or decrease	____________ft.	*Height changes from WEMS discharge to drip field.*
U) Total static head	____________ft.	*Add (Ti) + (Tii)*

(WORKSHEET 2 CONT. ON NEXT PAGE

V) Friction head

i) Equivalent length of fittings	____________	ft.	*Estimate loss through fittings - usually inconsequential for small systems.*
ii) Distance from pump to field.	____________	ft.	*Measure length of sub-main*
iii) Total equivalent length of pipe.	____________	ft.	*Add (Vi) + (Vii)*
iv) Total effective feet.	____________	ft.	*(Viii) / 100 x (S)*
v) Head required at drip field	____________	ft.	*See line (I) in Worksheet 1 above.*
vi) Head loss through Cyclone filter	13	ft.	*Use this fixed measurement for calculating total head*
vii) Head loss through zone valves If applicable	____________	ft.	*Check with manufacturer for pressure loss* *Multiply pressure loss in psi by 2.31 to get head loss.*
W) Minimum Total friction head	____________	ft.	*Add (Viv) + (Vv) + (Vvi) + (Vvii)*
X)Minimum Total Dynamic Head	____________	ft.	*Add (U) + (W)*
Y) Minimum pump gpm not including recycle	____________	gpm	From (N)

* Z) Choose the pump

____________________Model Number

*Use (x) and (y) in cooperation with the four pump curves on the previous page to choose pump.
Note: When (Y) is less than 15 gallons per minute, use 15 gpm when determining the pump.
This assures proper filter flow.

Za.) Maximum pump gpm @ total dynamic head	____________	gpm	Using curve for selected pump, use "X" to determine. "Za" is used in spin plate selection on page 39.

MICRO DOSE TIMER

CALCULATING THE ON/OFF CYCLE

A) Quantity of effluent to be dispersed per day (daily flow). [See worksheet 1, page 24, "A)".]

__________________ gpd

K) Determine total drip emitter flow for the field. [See worksheet 1, page 24, "K)".]

__________________*gpm*

As a rule, each pump cycle (dose) needs to be 30 to 100 gallons. Large fields can be toward the higher number and small fields can be toward the lower number. Choose the dose volume that suits your field size.
DOSE VOLUME:_____________***gallons***

Take your **DOSE VOLUME** # and divide it by { **K)** } and this will give you pump run time (on cycle).

*** TIMER ON CYCLE:**_________________***minutes***

Take { **A)** } and divide by your **DOSE VOLUME** #, then add **2 to 4** extra doses as a safety factor for added use. This will give you # of required doses per day.

 # OF *REQUIRED* DOSES ______________

Take **<u>1440</u>** minutes (24 hours) and divide by the **# OF *REQUIRED* DOSES,** then subtract the **TIMER ON CYCLE #.** This will give you the pump off time (off cycle).

* **TIMER OFF CYCLE:**___________________***minutes*** *(Round down to whole #)*
Note: To set timer, convert to hours and minutes.
Divide minutes by 60 which = hours.

***Timer on/off time**

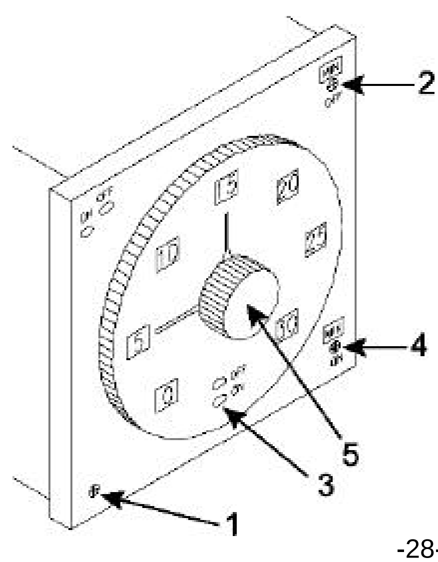
SETTING THE TIMER

A. Determine "ON" (#4) and "OFF" (#2) time and turn (using a screw driver) the corresponding dial to the appropriate time unit.

B. See (#1), select the most appropriate time range by turning the time range selector dial (using a screwdriver).

C. See (#3), set the "OFF" time by turning the outer dial (green pointer) to the correct time setting.

D. See (#5), set the "ON" time by turning the inner dial (orange pointer) to the correct time setting.



DESIGN PARAMETERS:

1. WATER QUALITY

Be aware of water conditions intrinsic to the area. If iron or iron bacteria is prevalent, please be sure to eliminate it upstream of the drip system with ozone, ultraviolet or chemical treatment. Iron can be recognized as orange stain on plumbing fixtures and may be treated prior to entering the facility.

2. SOIL APPLICATION DESIGN

Note: This section based on Subsurface Trickle Irrigation System for On-Site Wastewater Disposal And Reuse by B. L. Carlile and A. Sanjines. The basis of the information is from the Texas Health Department regulations. The rules in your County and State may vary.
The instantaneous water application rate of the system must not exceed the water absorption capacity of the soil. A determination of the instantaneous water absorption capacity of the soil is difficult, however, since the value varies with the water content of the soil. As the soil approaches saturation with water, the absorption rate reduces to an equilibrium rate called the “saturated hydraulic conductivity.” Wastewater application rates should be less than 10 percent of this saturated equilibrium.

Even though the trickle irrigation system maximizes the soil absorption rate through the low rate of application, thus keeping the soil below saturation, there will be times when the soil is at or near saturation from rainfall events. The design must account for these periods and assume the worst case condition of soil saturation. *By designing for a safety factor of 10 or 12, based on the saturated hydraulic conductivity, the system will be under-loaded most of the time but should function without surface failure during extreme wet periods.*

By applying wastewater slowly for a few hours daily, particularly if applied in “pulses” or short doses several times per day near the soil surface where the soil dries the quickest would keep the soil absorption rate at the highest value and minimize the potential of water surfacing in poor soil conditions.

As stated previously, this design criterion will under-load the system at all times except when the soil is at or near saturation from rainfall. If designing for an efficient irrigation system, the water supply may not be sufficient to meet the demands of a lawn or landscaped area during peak water demand months. This problem can be overcome by either of two solutions: add additional fresh-water make-up to the system during the growing season to supply the needed water for plants in question, or split the system into two or more fields with necessary valves and only use one of the fields during the peak water demand months and alternate the fields during winter months or extremely wet periods, or use both fields simultaneously if the pump capacity will so allow.

TABLE 1. MINIMUM SURFACE AREA GUIDELINES TO DISPOSE OF 100 GPD OF SECONDARY TREATED EFFLUENT

		Soil Absorption Rates		Design	Total
Soil Class	Soil Type	Est. Soil Perc. Rate Minutes/in	Hydraulic Conductivity Inches/hr	Hydraulic Loading Rate gal/sq. ft. per day	Area Required sq. ft./100 gallons per day
I	Coarse sand	<5	>2	1.400	71.5
I	Fine sand	5 - 10	1.5 - 2	1.200	83.3
II	Sandy loam	10 - 20	1.0 - 1.5	1.000	100.0
II	loam	20 - 30	0.75 - 1.0	0.700	143.0
III	Clay loam	30 - 45	0.5 - 0.75	0.600	167.0
III	Silt - clay loam	45 - 60	0.3 - 0.5	0.400	250.0
IV	Clay non-swell	60 - 90	0.2 - 0.3	0.200	500.0
IV	Clay - swell	90 - 120	0.1 - 0.2	0.100	1000.0
IV	Poor clay	>120	<0.1	0.075	1334.0

Dispersal field area calculation:
Total square feet area of dispersal field = Design flow divided by hydraulic loading rate

Table 1 shows the recommended hydraulic loading rates for various soil conditions, using a safety factor of at least 12 with regard to the equilibrium saturated hydraulic conductivity rate of the soil. These loading rates assume a treated effluent with BOD and TSS values of less than 30 mg/l is produced in the treatment plant and that any anomalies such as iron bacteria have been removed prior to dosing.

NOTES

1) The above chart is provided as a guide only. States and Counties may have regulations that are different. Check your State guidelines and consult with your local health department.

2) Problems with drip dispersal fields occur when soils are misinterpreted. If in doubt, choose the more restrictive soil type from the table above.

3) “Soil type” should be based on the most restrictive layer within two feet of the dripline. In many soils 1-ft. vertical separation from the limiting layer has proven successful with secondary treated effluent. Hydro-Action and Geoflow recommend you follow State and Local guidelines.

4) Table 1 above, with only minor modifications over the years, has served Geoflow well since 1990 with tens of thousands of systems operating successfully based upon this data. However, thanks to work by Jerry Tyler and his associates at the University of Wisconsin-Madison soil structure has become better understood and can now be used as a comprehensive tool to determine optimal hydraulic loading rates.

Soil Textures	Soil Structure	Maximum Monthly Average	
		BOD5> 30mg/L<220mg/L TSS>30 mg/L<150 mg/L (gallons/ft2/day)	BOD5<30mg/L TSS<30mg/L (gallons/ft2/day)
Course sand or coarser	N/A	0.4	1.6
Loamy coarse sand	N/A	0.3	1.4
Sand	N/A	0.3	1.2
Loamy sand	Weak to strong	0.3	1.2
Loamy sand	Massive	0.2	0.7
Fine sand	Moderate to strong	0.3	0.9
Fine sand	Massive or weak	0.2	0.6
Loamy fine sand	Moderate to strong	0.3	0.9
Loamy fine sand	Massive or weak	0.2	0.6
Very fine sand	N/A	0.2	0.6
Loamy very fine sand	N/A	0.2	0.6
Sandy loam	Moderate to strong	0.2	0.9
Sandy loam	Weak, weak platy	0.2	0.6
Sandy loam	Massive	0.1	0.5
Loam	Moderate to strong	0.2	0.8
Loam	Weak, weak platy	0.2	0.6
Loam	Massive	0.1	0.5
Silt loam	Moderate to strong	0.2	0.8
Silt loam	Weak, weak platy	0.1	0.3
Silt loam	Massive	0.0	0.2
Sandy clay loam	Moderate to strong	0.2	0.6
Sandy clay loam	Weak, weak platy	0.1	0.3
Sandy clay loam	Massive	0.0	0.0
Clay loam	Moderate to strong	0.2	0.6
Clay loam	Weak, weak platy	0.1	0.3
Clay loam	Massive	0.0	0.0
Silty clay loam	Moderate to strong	0.2	0.6
Silty clay loam	Weak, weak platy	0.1	0.3
Silty clay loam	Massive	0.0	0.0
Sandy clay	Moderate to strong	0.1	0.3
Sandy clay	Massive to weak	0.0	0.0
Clay	Moderate to strong	0.1	0.3
Clay	Massive to weak	0.0	0.0
Silty clay	Moderate to strong	0.1	0.3
Silty clay	Massive to weak	0.0	0.0

TABLE 2 DRIP LOADING RATES CONSIDERING SOIL STRUCTURE.
Table 2 (above) is taken from the latest State of Wisconsin code and reflects Jerry Tyler's work.

4. DEPTH AND SPACING

WASTEFLOW® drip fields usually have emitter lines placed on 2 foot (600 mm) centers with a 2 foot emitter spacing such that each emitter supplies a 4 sq. ft (0.36 m^2) area. These lines are best placed at depths of 6-10 inches (150 - 250 mm) below the surface. This is a typical design for systems in sandy and loamy soils with a cover crop of lawn grass. Closer line and/or emitter spacing of 12 inches is used on heavy clay soils or very coarse sands where lateral movement of water is restricted. Using closer spacing should not reduce the size of the field.

5. SOIL LAYERS AND TYPES

The shallow depth of installation is an advantage of the subsurface drip field since the topsoil or surface soil is generally the most biologically active and permeable soil for accepting water. The topsoil also dries the fastest after a rainfall event and will maintain the highest water absorption rate. The quality and homogeneity of the soil may present a problem. If the soil was not properly prepared and there are pieces of construction debris, rocks and non-uniform soils, it is very difficult to obtain uniform water spread. In many cases, particularly if the soil is compacted, soil properties can be greatly improved by ripping and disking.

6. ADDING FILL TO THE DISPERSAL FIELD
Some dispersal sites require additional soil be brought in for agronomic reasons or to increase separation distances from the restrictive layer. Restrictive layers stop or greatly reduce the rate of downward water movement, as a result surfacing may occur during part of the year. In soils with high water tables, treatment is minimized due to a lack of oxygen.

Placing drip lines in selected fill material above the natural soil provides an aerated zone for treatment. Dispersal however still occurs in the natural soil and the field size must be based on the hydraulic capability of the natural soil to prevent hydraulic overload.

Any time fill material is to be used; the area to receive the fill should have all organic material removed or it must be incorporated into the natural soil to prevent an organic layer from forming and restricting downward water movement.

The fill material should be applied in shallow layers with the first 4 to 6 inches incorporated into the natural soil to prevent an abrupt textural interface. Continue this process until all fill has been incorporated.

The fill area should be left crowned to shed surface water and may need diversion ditches or some other devices to prevent surface water from infiltrating. The entire fill area should have a vegetative cover to prevent erosion. If possible allow the fill to set at least seven to ten days before installing WASTEFLOW® PC dripline.
It is generally agreed that fill should not be used on slopes greater than 20%.

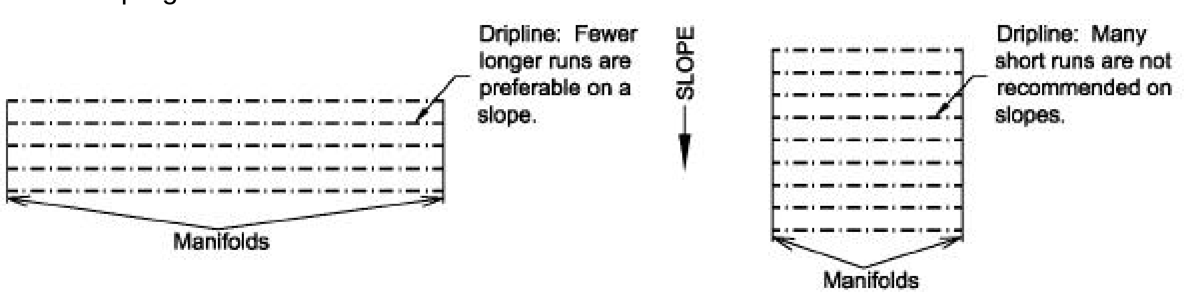
7. HIGH POINTS, SIPHONING AND SLOPES
A potential problem with buried drip lines is siphoning dirt into the emitters when the pump is switched off. For this reason:

a. Drip lines should have a fairly constant slope. Run dripline along a contour.
b. At least one vacuum breaker should be installed at the highest point in each zone.
c. Avoid installing lines along rolling hills where you have high and low points along the same line.
d. Drip lines should be connected at the end to a common return line.

8. EXCESSIVE ELEVATION DIFFERENCES
When elevation in a drip field zone exceeds 6 feet, use WASTEFLOW® PC tubing.

WASTEFLOW® PC: WASTEFLOW® PC can tolerate very large height variations provided the pressure remains within the 7 to 60 psi range, and preferably within 10 to 45 psi.

At the end of each dosing cycle, water in the dripline will flow down to the bottom lines within the drip zone. This is called “lowhead drainage”. On a slope site Geoflow recommends installing short manifolds with fewer lines and longer dripline runs. If unsure, a maximum of 1500 ft of Geoflow dripline within each zone or sub-zone can be used as a rule of thumb. Do not exceed 5 lines in a multiple zones or sub-zone with a slope greater than 10%.



9. HILLY SITE

Concentrate drip lines at the top of the hill with wider spacing towards the bottom. In the case of compound slopes consult a professional irrigation designer or engineer.

10. MULTIPLE ZONES

Drip dispersal fields can be divided into multiple zones or sub zones with solenoid valves or index valves for the following reasons:

a. Steep slopes with a risk of lowhead drainage can be subdivided to distribute the water at system shutdown more uniformly in the field.
b. Smaller zones reduce the required flow per minute which consequently reduces the size of the pump, supply and return lines.
c. If the dispersal field is located in multiple areas on the property.
d. To accommodate varying soils or vegetation on a single site.

Note. On multiple zones, a single TurtleDrip™ WEMS can be used for filtration and flushing by placing zone valves downstream of the WEMS. All zones would require a check valve on the individual flush lines upstream of each line joining a common flush line to keep flush water from one zone entering any other zone during the flush cycle. (See Geoflow Design Detail No. 588)

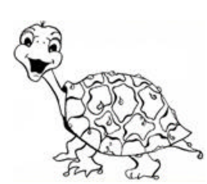
****

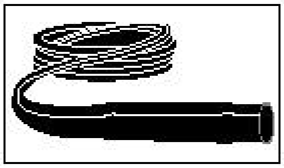
11. REUSE FOR IRRIGATION

A good vegetative cover is an advantage to prevent erosion from the field and utilize water applied to the rooting zone. Sites should be planted or seeded immediately after installation. Grasses are particularly suitable for this application. Most lawn grasses will use 0.25" to 0.35" (6.3-8.9mm) of water per day during the peak-growing season. This calculates to be about 0.16 to 0.22 gal/ft ^{2} /day. Over-seeding lawns with winter ryegrass can continue this use efficiency continued through much of the year. For vegetation using 0.16 to 0.22 gal/ft ^{2} /day by evapotranspiration, a sewage flow of 1000 gallons per day would supply the water needs of a landscaped area of 4600 to 6400 sq. ft. without having to add fresh water. For areas larger than this, the plants will suffer water stress during the hot months unless additional fresh water is applied.

12. WATER APPLICATION FORMULA

To determine the rate of application for various drip irrigation designs, use the following formula:
Water application (inches per hour) = (231 x (emitter flow rate gph)) / ((Emitter spacing inches) x (dripline spacing inches))
Example: Dripline with 1.3 gph flow rate emitters spaced 24" apart and dripline spaced 24" apart.
Water application = (231x1.3)/(24x24) = 0.52 inches of water per hour.





WASTEFLOW® DRIPLINE

DESCRIPTION
The flexible 1/2" polyethylene dripline has large emitters regularly spaced in the line. With the dripline hidden about six inches below ground effluent is distributed slowly and uniformly, reducing ponding, even in difficult soils and hilly terrain.

WASTEFLOW® is built to last. It is guaranteed to be trouble-free from root intrusion with built-in *ROOTGUARD*® protection, and the dripline wall is protected from organic growth with a bactericide lining.

WASTEFLOW® provides uniform distribution. The emitters have a Coefficient of variation (Cv) of less than .05.

Different flow rates, dripline diameters and emitter spacing can be special ordered.

Use 600 series compression adapters or spinloc fittings to connect the dripline to PVC pipe.

ROOTGUARD® PROTECTION
WASTEFLOW® dripline features patented *ROOT GUARD*® technology to prevent roots from clogging the emission points. The pre-emergent, Treflan®, is bound into *WASTEFLOW*® emitters when they are molded to divert roots from growing into the emitter outlet. The system is guaranteed against root intrusion for 10 years.

BACTERICIDE PROTECTION
Ultra-Fresh DM50 is incorporated into the inner lining and emitters of *WASTEFLOW*® dripline to prevent bacteria from forming and eliminates the need to scour the tubing. It is a tin based formula that defeats the energy system of microbial cells.

WHEN TO USE WASTEFLOW® PC
Geoflow, Inc. offers WASTEFLOW® dripline in pressure compensating (WASTEFLOW® PC)

We recommend that WASTEFLOW® PC be used when the advantages are of substantial economic value.

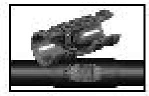
a) Very long runs.

b) Steep slopes. Systems should be designed for the dripline lateral to follow the con-tour.

c) Rolling terrain. If the difference in height from trough to peak exceeds six feet then WASTEFLOW® PC should be used.

*Vacuum relief valves must be placed at the top of each rise.

WASTEFLOW® PC 0.53 GPH



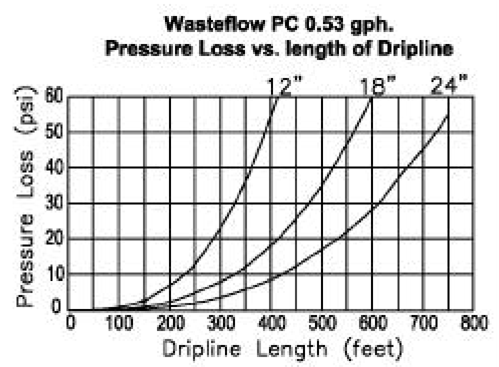
WFPC16-2-24 WASTEFLOW® PC 24″ / .53gph

WFPC16-2-18 WASTEFLOW® PC 18″ / .53gph

WFPC16-2-12 WASTEFLOW® PC 12″ / .53gph

Alternative spacing, flow rates and diameters available upon request

Pressure	Head	WFPC16-2-24 WPFPC16-2-18 WFPC16-2-12
7-60 psi*	16-139 ft.	0.53 gph



Maximum Length of Run vs. Pressure
Wasteflow® PC
Allows a minimum of 10 psi in the line
*Recommended operating pressure is 10-45 psi

Kd = 2.070

Pressure	Head	WFPC 16-2-24	WFPC 16-2-18	WFPC 16-2-12
10 psi	23.10 ft.	—	—	—
15 psi	34.65 ft.	321 ft.	260 ft.	174 ft.
20 psi	46.20 ft.	423 ft.	330 ft.	228 ft.
25 psi	57.75 ft	478 ft.	377 ft.	260 ft.
30 psi	69.30 ft.	535 ft.	415 ft.	288 ft.
35 psi	80.85 ft	576 ft.	448 ft.	313 ft.
40 psi	92.40 ft.	613 ft.	475 ft.	330 ft.
45 psi	103.95 ft	651 ft.	501 ft.	354 ft.
50 psi*	115.50 ft	675 ft.	523 ft.	363 ft.
55 psi*	127.50 ft	700 ft.	544 ft.	377 ft.
60 psi*	138.60 ft	727 ft.	563 ft.	403 ft.

WASTEFLOW® PC Specification

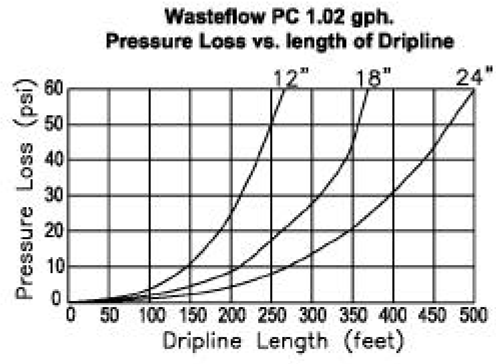
The dripline shall consist of nominal sized one-half inch linear low density polyethylene tubing, with turbulent flow, drip emitters bonded to the inside wall. The drip emitter flow passage shall be 0.032″ x 0.045″ square. The tubing shall have an outside diameter (O.D.) of approximately .64-inches and an inside diameter (I.D.) of approximately .55-inches. The tubing shall consist of three layers; the inside layer shall be a bactericide protection, the middle layer shall be black and the outside layer shall be purple striped for easy identification. The dripline shall have emitters regularly spaced 24″ (or 18″ or 12″) apart. The pressure compensating emitters shall be molded from virgin polyethylene resin with a silicone rubber diaphragm. The pressure compensating emitters shall have nominal discharge rates of 0.53 gallons per hour. The emitters shall be impregnated with Treflan ® to inhibit root intrusion for a minimum period of ten years and shall be guaranteed by the manufacturer to inhibit root intrusion for this period. 0.53 gph WASTEFLOW® PC pressure compensating dripline shall be Geoflow model number WFPC16-2-24 (or WFPC16-2-18 or WFPC16-2-12)

WASTEFLOW® PC 1.02 GPH

WFPC16-4-24 WASTEFLOW® PC 24″ / 1.02gph

WFPC16-4-12 WASTEFLOW® PC 12″ / 1.02gph

Alternate spacing available upon request.



Flow Rate vs. Pressure		
		Dripline
Pressure	Head	WFPC16-4-24 WFPC16-4-12
7 – 60 psi*	16 – 139 ft.	1.02 gph

Maximum Length of Run vs. Pressure
Allows a minimum of 10 psi in the line
*Recommended operating pressure is 10 - 45 psi

Kd = 2.070

Pressure	Head	WFPC 16-4-24	WFPC 16-4-18	WFPC 16-4-12
10 psi	23.10 ft.	—	—	—
15 psi	34.65 ft.	211 ft.	172 ft.	115 ft.
20 psi	46.20 ft.	265 ft.	210 ft.	146 ft.
25 psi	57.75 ft	315 ft.	242 ft.	171 ft.
30 psi	69.30 ft.	335 ft.	266 ft.	180 ft.
35 psi	80.85 ft	379 ft.	287 ft.	199 ft.
40 psi	92.40 ft.	385 ft.	305 ft.	211 ft.
45 psi	103.95 ft	429 ft.	321 ft.	222 ft.
50 psi*	115.50 ft	431 ft.	334 ft.	232 ft.
55 psi*	127.50 ft	449 ft.	347 ft.	240 ft.
60 psi*	138.60 ft	465 ft.	360 ft.	249 ft.

WASTEFLOW® PC 1.02 GPH Specification
The dripline shall consist of nominal sized one-half inch linear low-density polyethylene tubing, with turbulent flow, drip emitters bonded to the inside wall. The drip emitter flow passage shall be 0.032″ x 0.045″ square. The tubing shall have an outside diameter (O.D.) of approximately .64-inches and an inside diameter (I.D.) of approximately .55-inches. The tubing shall consist of three layers; the inside layer shall be a bactericide protection, the middle layer shall be black and the outside layer shall be purple striped for easy identification. The dripline shall have emitters regularly spaced 24″ (or 12") apart. The pressure compensating emitters shall be molded from virgin polyethylene resin with a silicone rubber diaphragm. The pressure compensating emitters shall have nominal discharge rates 1.02 gallons per hour. The emitters shall be impregnated with Treflan ® to inhibit root intrusion for a minimum period of ten years and shall be guaranteed by the manufacturer to inhibit root intrusion for this period. 1.02 gph WASTEFLOW® PC pressure compensating dripline shall be Geoflow model number WFPC16-4-24 (or WFPC16-4-12).

AIR VACUUM BREAKERS

Description

Air Vacuum Breakers are installed at the high points of the WASTEFLOW® drip field to keep soil from being sucked into the drip emitters due to back siphoning or backpressure. This is an absolute necessity with underground drip systems. They are also used for proper draining of the supply and return manifolds in freezing conditions. Use one on the high end of the supply manifold and one at the high point of the flush manifold and any other high points in the system.

- Instant and continuous vacuum relief
- Non-continuous air relief
- Seals tight at 5 psi
- Durable, weather resistant
- Readily accessible pressure test point
- Easy to install
- Removable dirt cover
- Maximum flow of 50 gpm

Air Vacuum Specification

The air vacuum relief valve provides instant and continuous vacuum relief and non-continuous air relief. Both the body and the removable dirt cover shall be constructed of molded plastic. The body and the dirt cover shall be connected with a 3/4 inch hose thread. The ball shall be constructed of low density plastic and the internal seat shall be constructed of vinyl. The air vacuum relief valve shall seal at 5 psi. Inlet size shall be a 1 inch male pipe thread. The air vent shall be Hydro-Action item number 700004.

PVC 40 FRICTION LOSS CHART (Pounds per square inch (psi) per 100 ft. of pipe)

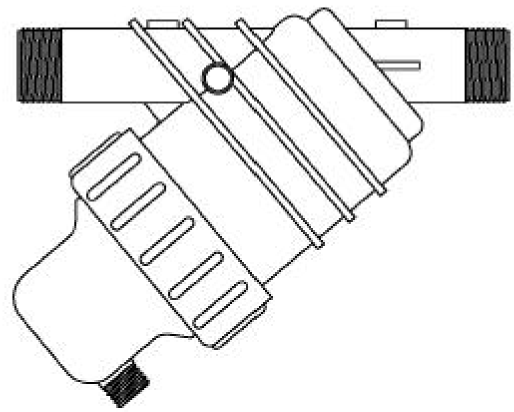
	1/2”		3/4”		1”		1 1/4”		1 1/2”	
Flow GPM	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI
1	1.05	0.43	0.60	0.11	0.37	0.03				
2	2.11	1.55	1.2	0.39	0.74	0.12	0.43	0.03		
3	3.17	3.27	1.8	0.83	1.11	0.26	0.64	0.07	0.47	0.03
4	4.22	5.57	2.41	1.42	1.48	0.44	0.86	0.11	0.63	0.05
5	5.28	8.42	3.01	2.15	1.86	0.66	1.07	0.17	0.79	0.08
6	6.33	11.81	3.61	3.01	2.23	0.93	1.29	0.24	0.95	0.11
8	8.44	20.10	4.81	5.12	2.97	1.58	1.72	0.42	1.26	0.20
10	10.55	30.37	6.02	7.73	3.71	2.39	2.15	0.63	1.58	0.30
15			9.02	16.37	5.57	5.06	3.22	1.33	2.36	0.63
20					7.42	8.61	4.29	2.27	3.15	1.07
25					9.28	13.01	5.36	3.42	3.94	1.63
30					11.14	18.22	6.43	4.80	4.73	2.27
35							7.51	6.38	5.52	3.01
40							8.58	8.17	6.30	3.88
45							9.65	10.16	7.09	4.80
50							10.72	12.35	7.88	5.83
60									9.46	8.17
70									11.03	10.87

	2” Pipe		2 1/2” Pipe		3” Pipe		4” Pipe		6” Pipe	
Flow GPM	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI
6	0.57	0.03								
8	0.76	0.06	0.54	0.02						
10	0.96	0.09	0.67	0.04						
15	1.43	0.19	1.01	0.08	0.65	0.03				
20	1.91	0.32	1.34	0.13	0.87	0.05				
25	2.39	0.48	1.67	0.20	1.08	0.07				
30	2.87	0.67	2.01	0.28	1.30	0.10				
35	3.35	0.89	2.35	0.38	1.52	0.13	0.88	0.03		
40	3.82	1.14	2.64	0.48	1.73	0.17	1.01	0.04		
45	4.30	1.42	3.01	0.60	1.95	0.21	1.13	0.05		
50	4.78	1.73	3.35	0.73	2.17	0.25	1.26	0.07		
60	5.74	2.42	4.02	1.02	2.60	0.35	1.51	0.09		
70	6.69	3.22	4.69	1.36	3.04	0.47	1.76	0.12		
80	7.65	4.13	5.36	1.74	3.47	0.60	2.02	0.16		
90	8.60	5.13	6.03	2.16	3.91	0.75	2.27	0.20		
100	9.56	6.23	6.70	2.63	4.34	0.91	2.52	0.24	1.11	0.03
125	11.95	9.42	8.38	3.97	5.42	1.38	3.15	0.37	1.39	0.05
150			10.05	5.56	6.51	1.93	3.78	0.51	1.67	0.07
175					7.59	2.57	4.41	0.68	1.94	0.09
200					8.68	3.40	5.04	0.90	2.22	0.12

Optimum velocity is 2 – 5 ft. per second. The pipe is Schedule 40.
ASTM D 1785, D2672, D1784 Cell Class 12454-A

CYCLONE FILTER

CYCLONE FILTER PROCESS DESCRIPTION



Wastewater effluent enters the filter via a 1 1/2” inlet and is forced through a directional nozzle plate onto the inside of the stainless steel screen. This cyclone action rotates debris down the screen wall to the large debris holding basin. Debris is flushed out a 3/4” flushing outlet located at the bottom of the holding basin. Cyclone action keeps more of the screen area clean minimizing pressure losses due to excess debris or solids buildup. For optimum self-cleaning action, the Cyclone Filter should be operated with the proper spin plate.

Filter Housing: Two-piece threaded housing with O-ring seal. Molded from high heat and chemical resistant ABS plastic. 3/4” flushing outlet molded into housing.

Filter Screen: All stainless steel providing 60.8 sq. in. of filtration area. Outer support shell is woven stainless steel wire; inner screen is specially woven stainless steel cloth. Inner and outer screens are soldered together. Screen collars molded from vinyl for long life and durability. Screen is 150 mesh / 100 micron. Maximum recommended working pressure is 80 PSI. Maximum recommended flow with 4-hole spin plate installed is 55 gpm.

Spin Plates: One of three spin plates is incorporated into the filter (2-hole, 3-hole, 4-hole) depending on the design flow of the drip system.

PLATE GUIDELINE	
PUMP	**PLATE**
½ HP High Head	2 HOLE
½ HP High Flow	* 2-3 HOLE
1 HP High Head	* 2-3 HOLE
1 HP High Flow	* 3-4 HOLE

When selecting spin plates for different pump sizes, the above chart is a guideline.

SPIN PLATE SELECTION – OPTIMUM FLOW RANGE		
SPIN PLATE	**MINIMUM GPM**	**MAXIMUM GPM**
2 HOLE	15 gpm	28 gpm
3 HOLE	30 gpm	42 gpm
4 HOLE	40 gpm	50 gpm

Note: To match proper spin plate to selected pump, refer to Worksheet 2 on page 27. Use “Za” (pump gpm) and the chart above to determine spin plate.

WORKSHEET 3- AS BUILT SYSTEM DESCRIPTION.

1. Sitename:____
2. Site address including State:_______________________________________
3. Drip field designed by: ____
4. Drip field installed by: ____
5. Date of installation: ________________________
6. Daily design flow: ____________________________*gpd*.
8. Soil type: ___________________________________
9. Pretreatment tank size ________________________
10. Treatment plant size_________________________
11. Pump tank size______________________________
12. OPS Model_________________________________
13. Model # of Wastewater Effluent Management System____________________________
14. Spin plate in Cyclone Filter_____________________
15. Effluent pump_______________________________
16. WASTEFLOW® PC dripline model # and/or description____________________________
17. Size (diameter) of supply manifold________________*inches*
18. Depth of supply manifold_______________________*inches*
19. Size (diameter) of return manifold________________*inches*
20. Depth of return manifold________________________*inches*
21. Number of zones in dripfield: ________________________________. If more than one zone, please describe valve (size, manufacturer, part number, type):_________________
22. Amount of dripline installed in each zone:
    Zone 1_______ *ft.* Zone 2_______ *ft.* Zone 3 _______*ft.* Zone 4_______ *ft.*
23. Flow rate per zone:
    Zone 1______ *gpm.* Zone 2______ *gpm*. Zone 3______ *gpm.* Zone 4_______ *gpm*.
24. Depth dripline installed below grade: _________________inches
25. #1 Performance data (*System Test*)
    Meter gpm ____________________
    Field Supply psi__________________

    #2 Performance Data (*Normal Operation*)
    Meter gpm ________________________
    Field Supply psi_____________________
    Field Return psi _____________________
    Filter psi ____________*in* ___________*out*
    Filter Flush gpm ____________________
    Field Flush gpm ____________________
26. Was any fill material supplied on the drip field?__________________
    If “yes”, describe fill quality and quantity added.
    ____
27. Please provide owner with as-built system drawings, including but not limited to direction of drip lines, location of air vents, pressure regulators and alternating valves if applicable.

HOME OWNERS GUIDE FOR CARE AND MAINTENANCE OF DRIP DISPERSAL FIELD

A drip dispersal system has been installed on your property for the subsurface dispersal of the effluent from your home.

The drip dispersal system consists of a series of 1/*2"* diameter drip tubing installed at a shallow depth of 8-1*0"* below the ground surface. It is designed to effectively disperse of the treated effluent in the ground with a combination of soil absorption and plant uptake. Your drip dispersal system will function for many years with only minimal maintenance being required, provided the following recommendations are followed:

- ❑ Establish landscaping (preferably a grass cover) immediately. This will stabilize the soil and allow for the vegetation to take up the water.
- ❑ Do not discharge sump pumps, footing drains or other sources of clear water to the system, except for the effluent discharge from your treatment system.
- ❑ Maintain all plumbing fixtures to prevent excess water from entering the dispersal system.
- ❑ Do not drive cars, trucks or other heavy equipment over the drip dispersal field (or the treatment unit itself). This can damage the drip components or the soil and cause the system to mal-function. Lawn mowers, rubber wheeled garden tractors and light equipment can be driven over the drip field.
- ❑ Do not drive tent stakes, golf putting holes, croquet hoops etc., into the dispersal field
- ❑ Contact your service company if your high water alarm should sound. The pump chamber is sized to allow additional storage after the high water alarm sounds but you should refrain from excessive water usage (i.e., laundry) until the system has been checked.
- ❑ After a temporary shut down due to a vacation or other reason, the treatment plant ahead of the drip field filter, initially may not function effectively, resulting in the filter blocking.

Contact your service company if you notice any areas of excessive wetness in the field. In most cases, this is usually caused by a loose fitting or a nicked dripline and can be easily repaired.
Note: There may be some initial wetness over the driplines following the system's installation. This should cease once the ground has settled and a grass cover is established.

TROUBLE SHOOTING GUIDE

Symptom: High water alarm activates periodically (1-2 times/week). During other times the water level in the pump chamber is at a normal level.

- *Possible cause*: Peak water usage (frequently laundry day) is causing a temporary high water condition to occur.
- *Remedy*: Set timer to activate the pump more frequently. Be sure to not exceed the total design flow. To avoid this, reduce the duration of each dose.
- *Remedy*: Provide a larger pump tank to accommodate the peak flow periods.

Symptom: High water alarm activates during or shortly after periods of heavy rainfall.

- *Possible cause*: Infiltration of ground/surface water into system.
- *Remedy*: Identify sources of infiltration, such as tank seams, pipe connections, risers, etc. Repair as required.

Symptom: High water alarm activates intermittently, including times when it is not raining or when laundry is not being done.

- *Possible cause*: A toilet or other plumbing fixture may be leaking sporadically but not continuously. Check water meter readings for 1-2 weeks to determine if water usage is unusually high for the number of occupants and their lifestyle. Also determine if water usage is within design range.
- *Remedy*: Identify and repair fixture.

Symptom: High water alarm activates continuously on a new installation (less than 3 months of operation). Inspection of the filter indicates it is plugged with a gray colored growth. Water usage is normal.

- *Possible cause*: Slow start-up of treatment plant resulting in the presence of nutrient in the effluent sufficient to cause a biological growth on the filter. This is typical of lightly loaded treatment plants that receive a high percentage of gray water (i.e., from showers and laundry).
- *Remedy*: Remove and clean filter cartridge in a bleach solution. Add a gallon of household bleach to pump tank to oxidize organics. Contact treatment plant manufacturer for advice on speeding up the treatment process possibly by "seeding" the plant with fresh activated sludge from another treatment plant.

Symptom: Water surfaces continuously at one or more isolated spots, each one-foot or more in diameter.

- *Possible cause*: Damaged drip line or a loose connection is allowing water be discharged under pressure and therefore at a much greater volume than intended.
- *Remedy*: Dig up drip line. Activate pump and locate leak. Repair as required.
- *Possible cause*: If water is at base of slope, can be caused by low-head drainage.
- *Remedy*: Install check valves and air vents in the manifolds to redistribute water in the system after pump is turned off. This is not advised for freezing climates where manifold drainage is required.

Symptom: A portion of the drip field closest to the feed manifold is saturated while the rest of the field is dry.

- *Possible cause:* Insufficient pump pressure. A pressure check at the return manifold indicates pressure of less than 10 psi.
  - *Remedy*: Check filter and pump intake to insure they are not plugged. If they are, clean as required.
  - *Remedy:* Leaks in the system may be resulting in loss of pressure. Check for water leaks in connections and fittings or wet spots in the field. Also check air vents to insure they are closing properly. Repair as necessary.
  - *Remedy:* Pump is worn or improperly sized. Pressure at feed manifold in less than 15 psi. Verify pressure requirements of system and provide a new or larger pump. As an alternate approach, the drip field may need to be divided into two or more zones.
- *Possible cause:* The duration of each dose is of insufficient length to allow the drip field to become pressurized before the pump shuts off (or runs for only a brief time before turning off).
  - *Remedy:* Increase the pump run time and decrease the frequency of doses. Always calculate (or observe during field operation) how long the system takes to fully pressurize and add this time to the design dosing duration.

Symptom: High water alarm begins to activate continuously after a long period (1-2 years) of normal operation. Inspection of the filter indicates it is plugged with a heavy accumulation of sludge.

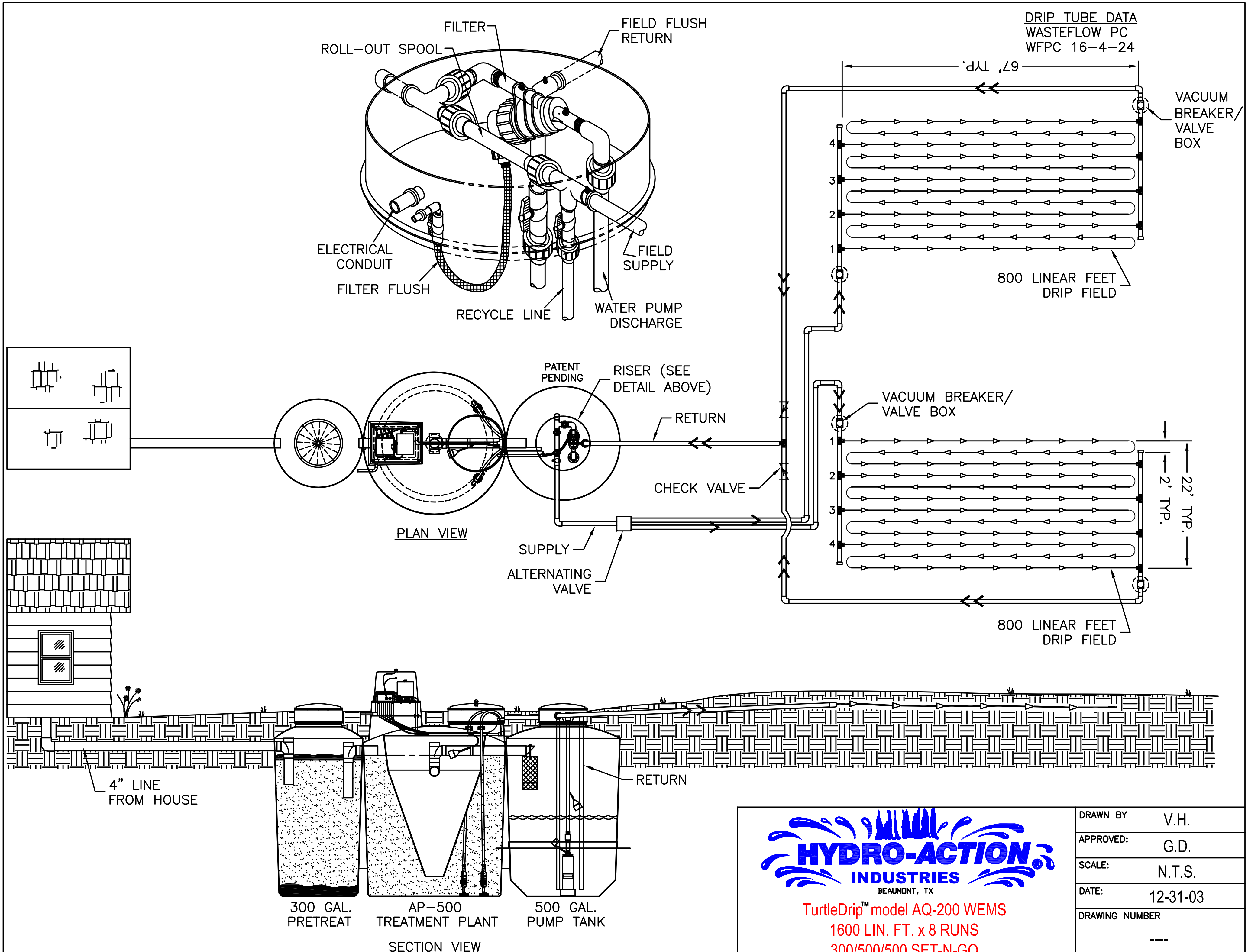
- *Possible cause:* A buildup of solids in the pump tank due to carryover from the treatment plant.
  - *Remedy*: Replace the filter cartridge with a clean cartridge. Check the pump tank and if an accumulation of solids is noted, pump the solids out of the pump tank. Also, check the operation of the treatment plant to insure it is operating properly.

Symptom: Water surfaces at several spots in drip field during dosing periods. Installation is recent, less than 6 months of usage and the soil is a moderate to heavy clay. Possibly, the installation was completed using a non-vibratory plow.

- *Possible cause:* Smearing of the soil may have occurred during installation of drip line. Also, the "cut" resulting from the installation allows an easy path for the water to surface during dosing.
  - *Remedy:* In most cases the sod will compact naturally around the drip line and the surfacing will diminish and ultimately cease. To help, reduce the duration of each dose and increase the number of doses/day. Also, it will help to seed the area to encourage the development of a good root zone.

Symptom: Entire area of drip field is wet, soft and spongy. It appears to be totally saturated with water. Situation occurs during dry season when there is little rainfall.

- *Possible cause:* Water being discharged to drip field exceeds design. Excess water may be a result of infiltration, plumbing leaks or excessive water usage.
  - *Remedy:* Check water meter, elapsed time meter, pump counter; override counter or high level alarm counter to determine if water usage is in excess of design. Check for leaks or infiltration. Repair leaks as required. Reduce water usage by installing water saving fixture.
  - *Remedy*: If water usage cannot be reduced, enlarge drip field as required.
- *Possible cause*: Area of drip field was inadequately sized and is too small.
  - *Remedy*: Provide additional soil analysis to verify sizing and enlarge as required.



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BEAUMONT, TX

TurtleDrip™ model AQ-200 WEMS
1600 LIN. FT. x 8 RUNS
300/500/500 SET-N-GO

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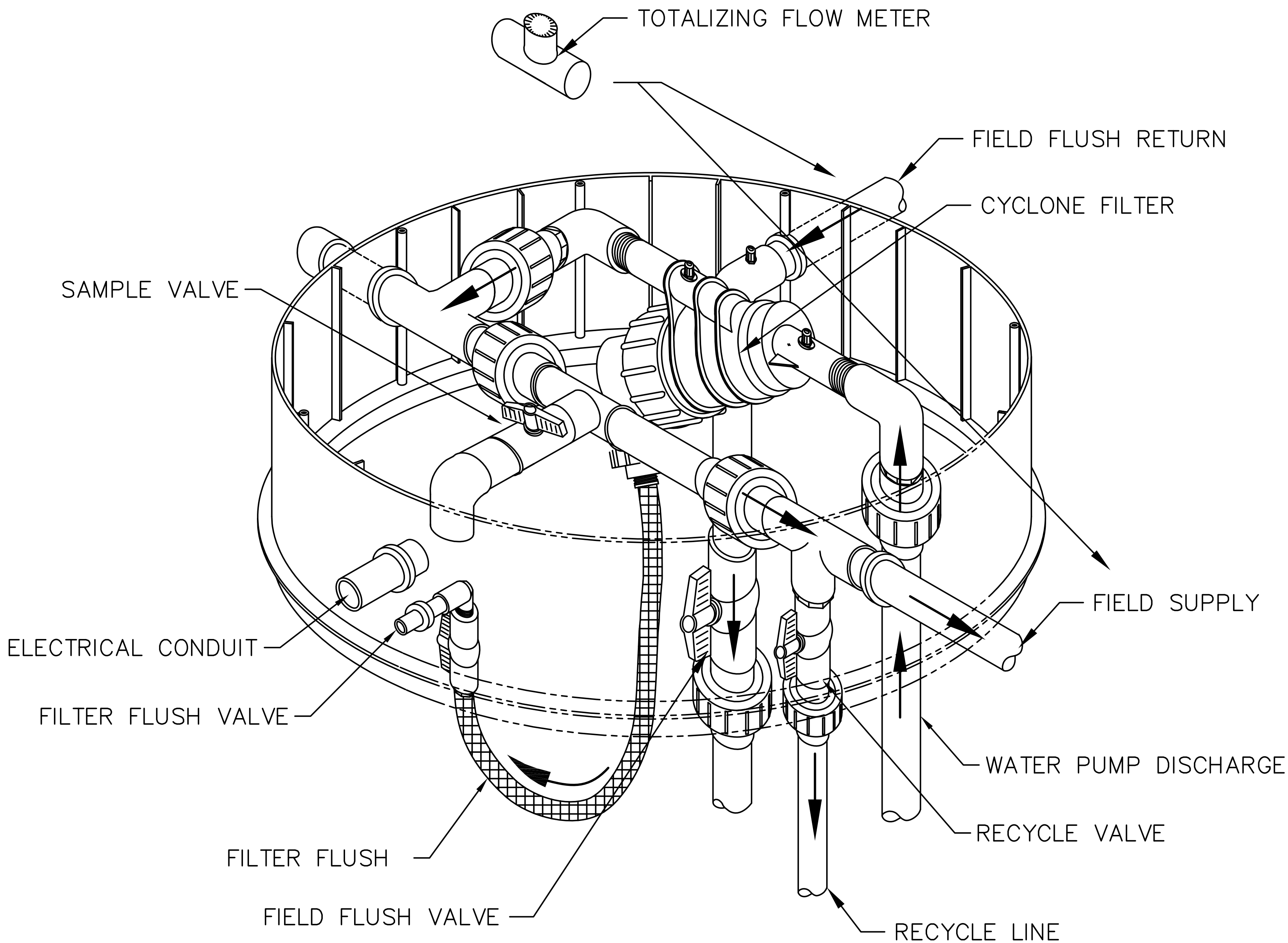

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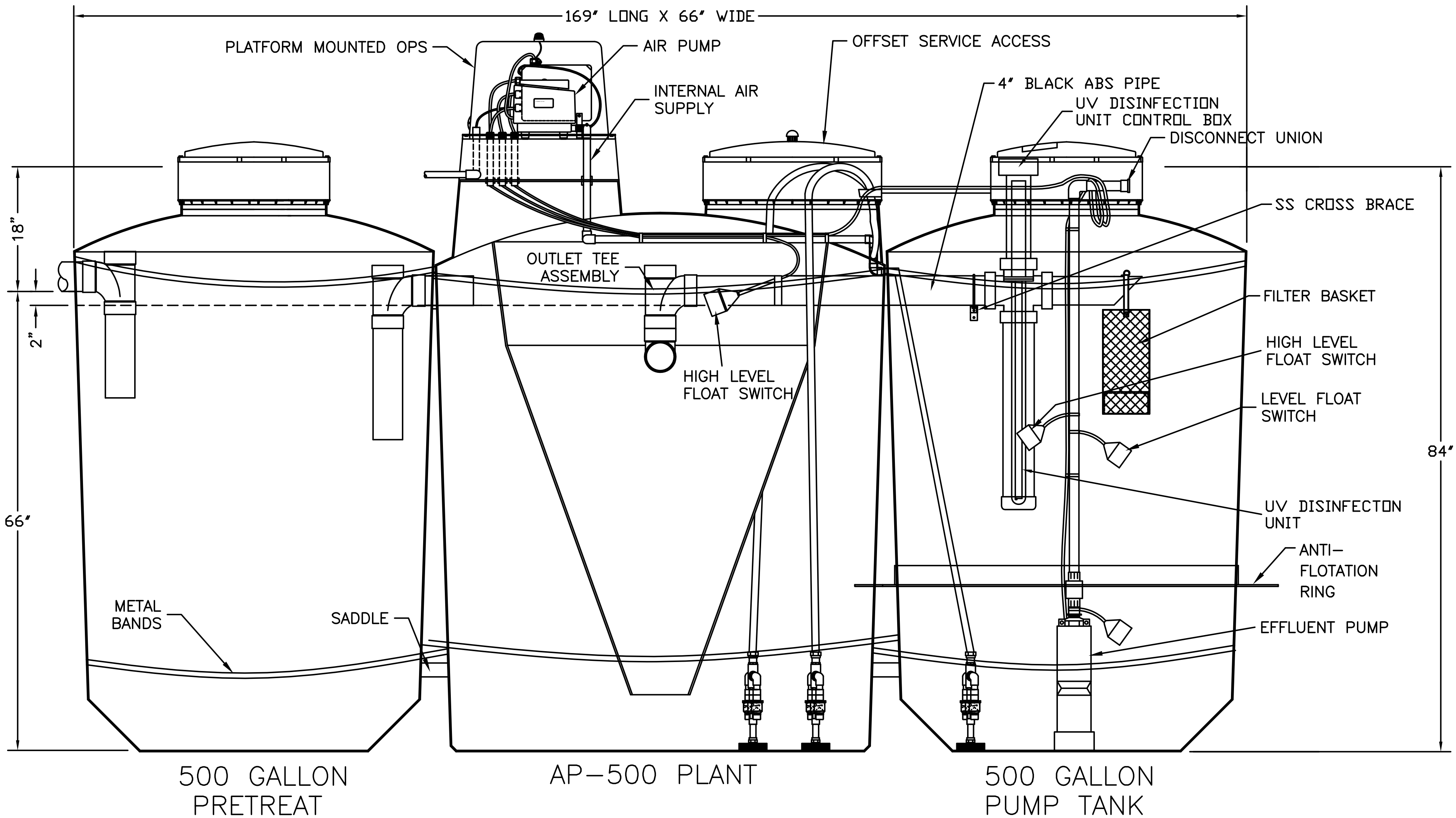

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Special thanks to Geoflow for their contributions to this manual.

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Sub-Surface
Dosing System